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## POLICY RESEARCH WORKING PAPER

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# Human and Physical Infrastructure

## Public Investment and Pricing Policies in Developing Countries

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Just as market failures necessitate government intervention in the infrastructure sectors, so government failures should be considered in deciding the extent and depth of that intervention.



## Summary findings

Almost by definition, the basis for development is infrastructure — whether services for human infrastructure (health, education, nutrition) or physical infrastructure (transport, energy, water).

Although the infrastructure sectors are diverse, what they have in common is that public policy has had a great deal to do with how these services are provided and financed in almost all countries. Jimenez reviews the recent literature on two key aspects of that involvement: investment and pricing.

While the quality of the econometric evidence varies, recent literature reinforces the view that human and physical infrastructure are critical for economic growth and the reduction of poverty. And the state is recognized as playing a key role in ensuring the efficient, equitable allocation of resources for infrastructure.

Despite many sound theoretical reasons for such public involvement, however, recent studies have shown that it leaves much to be desired in efficiency and equity. One symptom is underinvestment in key subsectors that have high economic returns and that help the poor the most, such as primary education and rural health clinics, in relation to more expensive interventions, such as tertiary education and urban hospitals. Another common malaise is the poor use of scarce resources, leading to low quality (students learning little) and reliability (irregular power and water flows), poor maintenance (dilapidated roads), and inappropriate input use (too many school administrators or health workers and not enough books or drugs in producing education health outcomes). Just as market failures necessitate government intervention in the infrastructure sectors, so government failures should be considered in deciding the depth and extent of that intervention.

The literature has made some advances in diagnosing these problems in poor countries and proposing solutions. But information gaps remain, particularly in developing robust methodologies for:

- Making intersectoral comparisons across the wide range of infrastructure services.
- Crafting more diverse policies about the public-private balance in infrastructure investment, depending on the nature of “public goods” characteristics for various types of infrastructure services, or even across activities for the same service (for example, power transmission versus distribution).
- Taking issues of political economy into account, such as the vested interests of those with large financial interests in infrastructure.

Jimenez also highlights public pricing as a policy initiative that has recently gotten much attention. After briefly reviewing the basic concepts of pricing, he focuses on the literature about pricing reform. Most commonly, the public sector is the main provider of infrastructure services, usually free or at subsidized prices. But the recent literature has aired a rethinking of the balance between public and private financing of infrastructure.

The debate in this area is often heated. Health and education are traditionally provided free and some recent literature argues for positive prices, at least for higher tiers of service. The principle of public pricing has been more widely accepted in transport, energy, and to a lesser extent water, but often the levels are too low and do not provide the appropriate incentives for efficient and equitable use.

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**Human and Physical Infrastructure:**  
**Public Investment and Pricing Policies in Developing Countries**

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**Human and Physical Infrastructure:  
Public Investment and Pricing Policies in Developing Countries**

**1. Introduction and Overview**

Almost by definition, infrastructure is the basis for development.<sup>1</sup> For an economy, it is the foundation on which the factors of production interact in order to produce output. This has been long recognized by development analysts, and infrastructure, often termed "social overhead capital," is considered to include:

...those services without which primary, secondary and tertiary production activities cannot function. In its wider sense it includes all public services from law and order through education and public health to transportation, communications, power and water supply, as well as such agricultural overhead capital as irrigation and drainage systems (Hirschman, 1958, p. 83)

These seemingly diverse services share some common traits that are important in economic analysis. They are generally not tradeable. Although they may affect final consumption directly, their role in enhancing output and household welfare can also be indirect -- in facilitating market transactions or in making other economic inputs more productive. Finally, and perhaps most importantly, the many infrastructure services share characteristics, such as scale economies in production, consumption externalities and non-exclusivity, that have been used to justify a large role for public policy in their provision and financing.

This chapter will focus not only on what has traditionally been considered the "core" infrastructure sectors, which enhance the productivity of physical capital and land (mainly transportation and power). It will also include human infrastructure -- or those services that raise the productivity of labor (health, education, nutrition). This is a broadening of the definition that was given great prominence by Schultz (1963) and Becker (1964) and that has since been widely accepted by both scholars and practitioners.

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<sup>1</sup>The dictionary's definition of "infrastructure" is "the underlying foundation or basic framework". See Webster's Ninth Collegiate Dictionary, 1985, p. 621.

Public investment will be defined broadly to include all government spending in these sectors, rather than just capital expenditures as traditionally defined in official statistics. This is to ensure that the economic issues regarding recurrent as well as capital spending are covered, since both have been the focus of the recent literature. Moreover, the chapter will emphasize recent policy debates, but will not present in detail the basic theoretical concepts underlying them. These can be obtained from standard public finance textbooks, and appropriate references will be made when necessary. There have been some recent shifts in emphasis on the analytic approach to infrastructure -- such as a greater focus on the efficiency of use, rather than on construction, and an increased role for private sector participation in providing infrastructure services. But the most dramatic advances have been made have been in the way the concepts are applied to the particular circumstances of developing countries.<sup>2</sup>

Because of its wide coverage, this chapter will stress the following common cross-sectoral themes regarding the pricing of and investment in infrastructure services in developing countries, rather than detailed issues within sectors:

- Recent studies at both the macro and micro level have reinforced the point that investments in human and physical infrastructure are critical elements for economic growth and for reducing poverty, although there has been less consensus on the magnitude of that effect (Section 2).
- While the literature continues to accept the key role of government in investment policy, there has been more of a debate about the nature of that role in order to improve efficiency and equity. There are two key questions: (1) how much and what type of service should be provided? and (2) what is the appropriate public-private balance in providing it? (Section 3).

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<sup>2</sup>For example, two of the World Bank's influential World Development Reports have been on Health (1993) and Infrastructure (1994).

- Given that the government has decided where to invest, how should these investments be financed? Section 4 shows that the recent literature has been reconsidering pricing policy so that it can play a greater role in financing.

The paper will then sum up briefly and then discuss areas where future research will be necessary, both in terms of substance and of the data needed to undertake that research (Section 5).

## **2. The Role of Infrastructure in the Development Process**

There are two types of evidence regarding the contribution that infrastructure makes to development. Aggregate evidence at the country, regional or sectoral level has most often been used to show how infrastructure can affect economic indicators, such as levels and growth of output. There has also been some work on the impact that infrastructure has had on aggregate social indicators. Micro evidence is used to depict how infrastructure influences household or individual welfare (human infrastructure) and the profitability of firms (physical infrastructure).

This section reviews this evidence, but the discussion will be succinct and selective. The literature is large and cross-references will be used to direct the reader to more detailed reviews (some of which are published in this Handbook or in its earlier editions). Also, the discussion will not focus on the differential impacts of publicly -- or privately -- provided infrastructure, since this will be the subject of the later sections regarding policy.

### **National and Cross-country Evidence**

A key question is whether variations in national economic growth and aggregate indices of welfare can be explained by (and attributed to) changes or differences in infrastructure variables. Before reviewing the empirical evidence, a brief overview of the underlying concepts might be useful.

Infrastructure can contribute to output directly as a measurable final product. Medical staff and hospitals combine to provide curative services that are valued for consumption and that improve a nation's social indicators. Buses and drivers combine with highways to provide passenger transport services.<sup>3</sup>

But its more important contribution may be indirect. As an intermediate input, it enhances the productivity of all inputs in producing output.<sup>4</sup> The quality of labor is enhanced by human capital improvements such as schooling. Physical capital and land are made more productive by investments that facilitate the transport of goods or the provision of power.

Moreover, as has recently been argued in the "new growth" economic literature, these indirect effects can give rise to externalities, which, if taken into account in investment decisions, can cause long-run growth to accelerate.<sup>5</sup> The more celebrated theoretical contributions have focused on human capital, although similar types of externalities are posited for physical capital. Romer (1986, 1990) argues that technological innovation, which is produced by human capital, is a public good so that private capital investment increases the level available to all entrepreneurs. Lucas (1988) emphasizes the externality associated with private investment in human capital -- because one worker increases the productivity of others (as well as his or

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<sup>3</sup>For example, gas, water and electricity are included as industrial sectors in national accounts calculations, while transport and communications are included as service sectors -- together their combined share in GDP varies between 5-11 percent in most countries (Kessides, 1993).

<sup>4</sup>Formally, infrastructure's direct and indirect effects can be represented (Hulten and Schwab, 1991) as:

$$(1) \quad Y_t = A(I_t, t) * f(K_t, L_t, T_t, I_t),$$

where output (Y) is determined by physical capital (K), labor (L), land (T), infrastructure (I) and technical progress (A) through a twice-differentiable function  $f(\cdot)$  and  $t$  is a time variable that allows for other differences in productive efficiency. Equation (1) varies from standard neoclassical formulations because of the effect of infrastructure investment in affecting  $A(\cdot)$ . Even if  $f(\cdot)$  exhibits constant returns to scale inclusive of I, the presence of I in the technical progress term gives rise to externalities, as suggested by recent proponents of the "new growth" literature.

<sup>5</sup>Chapter 41 by Lau in this volume contains a thorough review of the theoretical and empirical literature.



her own) in the process of interaction.<sup>6</sup> Becker et al. (1990) discusses increasing returns to human capital because investing in the quality of children has higher returns when human capital is abundant relative to investments in quantity.<sup>7</sup> These models assume that, because of externalities, factor returns do not necessarily diminish. Thus, increasing investment can accelerate economic growth -- hence the term, "endogenous growth".

In contrast, the neoclassical formulations associated with Solow (1956) invoked the simplifying assumptions of constant returns to scale, diminishing factor returns and the exogenous nature of the factors themselves to obtain closed form solutions.<sup>8</sup> These assumptions assured that all countries will converge to the same exogenously-determined steady state growth path -- a characteristic that is difficult to support empirically.

Ultimately, the validity of the competing theories rests on empirical work. What is the aggregate evidence regarding growth, investment and social outcomes?

Growth and human capital. The early aggregate studies using growth accounting methods (Denison, 1967, Kendrick, 1976) measured the contribution of variables that enhance the productivity of the measured inputs (like education) to the average annual rate of growth by inferring it from the residual of a growth equation, after the growth of labor and capital are taken into account. In education, for example, a review (Psacharopoulos, 1984) concluded that, although the quantitative results were widely disparate across

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<sup>6</sup>None of these arguments are particularly new, as is admitted by most of the recent authors, many of whom formalize ideas posited by earlier authors. Selowsky (1992) makes this point forcefully. Romer's (1986) ideas are close to those of Arrow (1962) and Phelps (1966) on learning by doing, while Lucas (1988) builds on Uzawa's (1962) work on increasing the returns that arise from external effects associated with human capital. What is innovative is that they are being used in formal models of economic growth with closed form solutions.

<sup>7</sup>Summers (1992) and Gill and Bhalla (1992) extend this argument to the importance of female human capital by stressing the positive association between the education of women and better health and greater enrollment of children in school.

<sup>8</sup>These assumptions lead to the "convergence" hypothesis. Diminishing returns and the diffusion of technology guarantee that all countries will have the same steady-rate of economic growth.

countries, qualitatively education had a positive effect on growth. But these studies were rooted in the neoclassical formulations of the Solow-type growth models and failed to isolate the effects of the possible externalities mentioned above.

Another approach that allows for possible externalities comes from econometric analysis of the relationship between output levels or growth and human infrastructure variables from historical and cross-section data. This link has been reviewed in several chapters of this Handbook -- Birdsall on population (Chapter 12), Schultz on education (Chapter 13), Behrman and Deolalikar on health and nutrition (Chapter 14) and Lau on general issues (Chapter 41) -- as well as other recent papers (for example, Behrman, 1990b; Weale, 1992 and Easterly et al. 1992). These reviews have generally found that, while there is some evidence that human resources contribute to growth, there is less consensus on the importance of that contribution -- both with respect to its magnitude and its nature (whether the externalities are pecuniary or technical). For example, two studies of about 100 countries find that a 10 percent increase in secondary school enrollment rates is associated with an increase in the growth rate of GDP per capita of 0.2 percent (Barro 1991) and 0.7 percent (Baumol et al., 1989; see Weale, 1992 for further comparisons).

The apparent lack of empirical consensus concerns important measurement and methodological problems that are only slowly being resolved. One set of issues has to do with obtaining an appropriate measure of human capital as an explanatory variable. This complexity can be illustrated for the case of education, where data are arguably more readily available than in other infrastructure sectors. Popular measures used in numerous early studies are school enrollment ratios and adult literacy rates (for example, Romer, 1990). These variables may not capture the contribution of changes in the directly-measured stocks of human capital. School enrollment ratios refer to flows of schooling, which may be inappropriate since there are usually long time lags before the results of the educational process emerge; and adult literacy rates capture only a very early stage of human capital formation that does not include numeracy, reasoning and other aspects that may have a major

impact on productivity. Both measures, which are typically obtained by U.N. specialized agencies from surveys of developing country institutions, also produce data of doubtful quality because of non-comparability across nations as well as a lack of monitoring on the production of the numbers.

More recently, census survey data have been used to construct measures of educational attainment. For example, Psacharopoulos and Arriagada (1986) use census-based data to compile the total educational stock of the labor force for 99 countries (although only 34 have more than one observation). Lau et al. (1991) takes a slightly different approach in using annual enrollment figures in a perpetual inventory model to estimate stocks of educational attainment for the working-age population. Barro and Lee (1993) uses census-based data (for 129 countries, 77 of which have three or more observations) as a benchmark and then combines them with enrollment ratios to estimate the educational attainment of the overall population aged 25 and above. While these studies are able to resolve the stock-flow issue, the data they use are still subject to criticism on quality grounds because: the enrollment ratios contain substantial measurement error; they are not sensitive to completion and retention rate differences across countries; and the interpolation techniques to fill in missing data points may not be duly sensitive to individual country conditions. This may be one reason why the results tend to be sensitive to what is included in the regression equations, which remain surprisingly ad hoc, in relation to the elegant theoretical models on which they are based.

The measurement issue also affects studies that attempt to use health, nutrition and population outcomes.<sup>9</sup> Available aggregate demographic and health data are notoriously incomplete, and are difficult to compare because of varying definitions. The UN's Demographic Yearbook distinguishes between "reliable" and "other" statistics by using italics. The World Bank's 1993 World Development Report explicitly highlights estimates based on old data, models and other approximations. The quality of the data is improving due to better collection methods and the availability of new data, such as from the

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<sup>9</sup>I am grateful to Ken Hill for his help in this assessment.

Demographic and Health Surveys (DHS) sponsored by USAID, although census coverage still leaves much to be desired. Data regarding child mortality and, to a lesser degree, total fertility are considered to be of better quality than data regarding adult mortality, which are very incomplete.

Another set of issues has to do with technical concerns about the estimation. Most important is the concern about simultaneity. Aggregate output and its growth can obviously affect many of the human capital variables that are used as explanatory variables.<sup>10</sup> Early attempts by Wheeler (1980) to correct for simultaneity suffered from a lack of instruments (see Behrman 1990b). Recent studies with access to more and better quality data have been able to argue that some of the variables used are indeed exogenous because of the way the lagged relationships are modeled (Barro and Lee 1993). Still, even these studies are criticized because of concerns that some variables may have been omitted, such as the effect of environmental variables on health outcomes and continued measurement error in the variables for which data do exist.

Growth and physical capital. The evidence on the link between physical infrastructure and growth is more diffuse and is only beginning to be reviewed (see, for example, Kessides, 1993). The nature of infrastructure services is much more variable, and it is difficult to develop aggregate measures of physical capital analogous to indicators of the human condition. Aggregate infrastructure (which is usually a combination of diverse sectors like transport and communications and some components of the "economic services" category of the national accounts) has shown that there can be a substantial positive effect. Aschauer's (1989) study of the U.S. evidence, using a production function approach, indicates that the contribution of basic infrastructure services is very large.

But such single-country studies over time are difficult to replicate in developing countries because of data constraints. Lakshaman and Elhance (1984) show that transport and power have a positive effect on industrial

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<sup>10</sup>Indeed, as is evident below, there is a whole literature about how national income determines socio-economic indicators such as educational and health outcomes, which are often the same variables used as proxies for human capital.

production in India. Among the few other studies in developing countries, one for Mexico (using a restricted cost-function approach) finds that there is some evidence that public physical infrastructure make both labor and capital inputs more productive (Shah 1992), although the rate of return is lower than that for private capital.

Cross-country evidence does exist that links a variety of specific infrastructure outcomes with growth or other measures of overall economic performance. Table 1 cites some aggregate evidence of the results mentioned above for agriculture, the sector in which the coverage of data is probably best. Roads and road density have a strong positive effect on agricultural output. Irrigation also has a significant effect on aggregate output.

*Table 1: Effects of Infrastructure on Agriculture: Cross-country Evidence<sup>2/</sup>*

| <i>Due to 1% increase in</i> | <i>Increase of Aggregate Crop Output (%)</i> |
|------------------------------|--|
| Irrigation                   | 1.62*  |
| Paved roads                  | .26*   |
| Rural road density           | .12*   |
| Adult literacy rate          | .54  |

\* Statistically significant at 10%.

<sup>2/</sup> Cross-country study - 58 countries.

Source: Binswanger, H. (1990)

Other variables that have been used in cross-country analysis include: telephone coverage per capita (Hardy and Hudson, 1981) and the extent of paved road networks (Querioz, 1992). These have been shown to be significant in explaining differences in GDP per capita across countries. One study finds that an indicator of spending on transport and communications services has a significant effect on some categories of sectoral output, such as agricultural productivity (Antle, 1983). Manufacturing investment is also found to depend on infrastructure quality (Wheeler and Mody, 1991). These studies found strong correlations between lagged values of these variables and GDP per

capita, but econometric problems may persist as the lag structures may not fully account for simultaneity.

Studies that use physical measures of capital, such as those cited above, are few. A more popular approach is to use data on the shares that each sector (typically transportation and communication, but also of gas, water and electricity) contributes to total output (World Bank, 1987b) or to public spending (Devarajan et al., 1992; Easterly and Rebelo, 1993) as explanatory variables of per capital GDP levels or growth. Most of these studies suffer from many of the same econometric and measurement problems described above for human infrastructure. For example, they cannot control adequately for simultaneity, so that the causality between economic growth and the provision of infrastructure is not clear. Moreover, many of the studies cannot be used directly for policy analysis because the sector definitions are too broad or because they do not consider variations in quality or utilization.

Interpretation of the results is also a concern. First, using overall sectoral shares confounds the differential effects of public and private spending, making it nearly impossible to derive clear policy implications. Correcting for this may be difficult since data on private spending are scarce and many private infrastructure utilities receive large amounts of public subsidies. Moreover, it is critical not to lump together wasteful infrastructure "white elephants" with productive investments. Second, studies that rely on public spending patterns may not capture the true effect of infrastructure if there is widespread waste in spending (see Devarajan et al., 1992).

Another way to measure the impact of public infrastructure investment on development is to consider its effect on private investment. Studies using data from developing countries (see reviews in Chhibber and Dailami, 1990; Serven and Solimano, 1992) indicate that public infrastructure investment "crowds in" private investment, while the opposite is true for non-infrastructure investment. These points are discussed in the next section on investment policy.

Social indicators and infrastructure. Levels and growth of aggregate output measure only one aspect of overall economic development. Another important set of indicators is the direct measure of health and social variables. For an in-depth discussion on the reasons for distinguishing between these two aspects, see the chapter by Lipton and Ravallion (Chapter 42).

Aggregate data have been used to illustrate that social indicators have been improving over time (World Bank, 1990; Kakwani, 1992). Infant mortality rates have been dropping, although Kakwani (1992) finds that the progress made by the low-income countries, which was superior to that made by middle-income countries until the mid-1970s, seems to have lost momentum in subsequent periods. Literacy rates have shown a strong upward trend, consistent with the parallel gains in primary school enrollment rates. Moreover, policy documents have loosely used broad correlations to show that access to infrastructure, particularly social services and water, has had much to do with these gains. One such example is the World Bank's 1990 World Development Report:

"In 1985, spending on primary education as a percentage of GNP was more than four times higher in Botswana, where the enrollment rate was 99 percent, than in Haiti, where it was only 55 percent. Similarly, in countries that have achieved broad provision of health care, such as Chile and Mauritius, spending as a percentage of GNP is several times greater than in countries such as India and Pakistan, where under 5 mortality remains exceptionally high and the percentage of children immunized is low" (p. 46).

While intuitively appealing, these contentions cannot be considered to be rigorous evidence of the impact of infrastructure on social indicators. The quality of the data on aggregate educational and health outcomes has already been discussed above. Moreover, there is the taxing question of simultaneity -- it is likely that educational outcomes, for example, proxy for overall levels of economic development and can equally explain the amount of investment countries can afford to make. Finally, questions about the efficacy of public investment can be raised because there are typically no controls in these studies for differences in quality.

Conclusions. The positive link between measures of infrastructure and development is fairly robust across studies and methodologies. However, it is more difficult to pin down the quantitative evidence regarding this impact, particularly that of aggregate measures of physical infrastructure (see Polenske and Rockler 1993). This is because of the difficulty in measuring and deriving a precise methodology that clearly defines causality between infrastructure outcomes and development measures. Consequently, while such studies are useful for raising overall consciousness about the importance of infrastructure, they are less useful for guiding policy. Moreover, even if the measurement and methodology questions were addressed, policy instruments at the aggregate level are often difficult to interpret. This is because of the need to differentiate between publicly - versus privately - provided capital. The studies that do differentiate in this way rely on spending data, but such spending may not lead to great improvements in the physical capital stock if they are not done efficiently; also they measure flows and not stocks of capital.

#### Microeconomic Links

The uneven nature of the aggregate evidence has meant that much more of the burden of documenting the effects of infrastructure on productivity has rested on microeconomic data at the individual or enterprise level. This evidence also has a direct bearing on the question of what effect infrastructure has on poverty reduction since increasing productivity is one of the principal ways for the poor to escape poverty and since many of the studies also focus on poorer households and smaller firms.

Direct effects of human capital. The link between human resources and productivity has been the subject of a large number of studies, particularly in education, health and nutrition, which is only briefly summarized in what follows."

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"See Behrman (1990a) for a more thorough review of these issues. Some of these ideas also arise in the context of the discussions in previous chapters of this Handbook by Strauss and Thomas in this volume, Behrman and Deolalikar (Chapter 14) and Schultz (Chapter 13).



Much of the microeconomic evidence comes from studying the impact of education on wages. Studies (mainly using earnings functions) consistently find that there is a large labor market premium on attaining additional years or levels of schooling. Table 2 shows the magnitude of this impact for a number of countries. When compared to the costs of obtaining that education, many conventional estimates put these rates of return at levels that are typically above those of physical rates of return (Psacharopoulos, 1985). These estimates, summarized in Table 3 as averages of individual studies, also reveal that returns to education tend to be highest for basic levels. Many of these studies have been criticized for a number of valid reasons, such as the possibility that these returns to education are due to credentialism, the inability to control for quality (Behrman and Birdsall, 1983), the possibility that the returns may have been dropping over time, and their failure to control for inter-regional differences. While some of these corrections could cause a decline in some of the estimates (particularly in the returns to expanding primary education versus improving its quality), in general, the general qualitative results and supporting evidence have been taken very seriously in policy advice.

**Table 2: The Effect of an Additional Year of Schooling on Wages and Farm Output, Selected Countries and Years**

|                            | Percentage increase in wages |              | Percentage increase in farm output |
|----------------------------|------------------------------|--------------|------------------------------------|
|                            | Male                         | Female       |                                    |
| Côte d'Ivoire, 1987        |                              | 12 P<br>21 S |                                    |
| Ghana, 1988/89             |                              | 5            |                                    |
| Korea, Rep. of, 1976, 1974 |                              | 6            | 2                                  |
| Indonesia, 1986            | 8                            | 12 S         |                                    |
| France, 1987               |                              | 11           |                                    |
| Peru, 1986                 | 13 P<br>8 S                  | 12 P<br>8 S  | 3                                  |
| Malaysia, 1987             | 16                           | 18           | 5                                  |
| Nicaragua (urban), 1985    | 10                           | 13           |                                    |
| Philippines, 1980          |                              | 18           |                                    |
| Spain, 1979                |                              | 10           |                                    |
| Thailand, 1986; 1973       | 17 P<br>7 S                  | 13 P<br>25 S | 3                                  |
| United States, 1967        |                              |              |                                    |
| Whites                     | 6                            | 7            |                                    |
| Blacks                     | 5                            | 11           |                                    |

P = primary school level.

S = primary school level.

**Note:** These results were all estimated controlling for other factors such as work experience and other individual characteristics. In most cases, the estimated effects have also been corrected for any statistical bias resulting from selecting a sample of wage earners only. The estimates for Côte d'Ivoire, Ghana, and Korea pertain to combined samples of men and women.

**Source:** Studies quoted in World Bank, 1991.

**Table 3: Returns to Investment in Education, by Country Type and Level**

| Region                                  | Social  |           |        | Private |           |        | Number<br>countries<br>reporting |
|---|---------|-----------|--------|---------|-----------|--------|----------------------------------|
|   | Primary | Secondary | Higher | Primary | Secondary | Higher |                                  |
| Africa                                  | 28      | 17        | 13     | 45      | 26        | 32     | 16                               |
| Asia                                    | 27      | 15        | 13     | 31      | 15        | 18     | 10                               |
| Latin America                           | 26      | 18        | 16     | 32      | 23        | 23     | 10                               |
| Europe, Middle East<br>and North Africa | 13      | 10        | 8      | 17      | 13        | 13     | 9                                |
| Developing Countries                    | 24      | 15        | 13     | 31      | 19        | 22     | 45                               |

Note: Private returns take into account only the cost of education to the individual. In contrast, social returns are based on the full cost of education to society, but as they do not attempt to measure social benefits, they are necessarily lower.

Source: Psacharopoulos (1985).

There is also evidence from the non-wage sector. Educated farmers are more likely to adopt new technologies, and virtually all studies on agricultural productivity show that better-educated farmers get a higher return on their land. Studies of Africa, for example, have found that farmers who have completed four years of education (the minimum many analysts conclude is necessary for literacy) produce, on average about 8 percent more than farmers who have not gone to school (Jamison and Lau, 1982). Similar positive effects have been found in studies in Korea, Malaysia and Thailand (see references in Behrman 1990a). Although there is not as much evidence that schooling improves informal sector employment and earnings in the rural non-agricultural sector, some studies -- including one of family businesses in Peru -- show that the more education a person has had, the wider the range of possibilities that is open for enhancing income (Moock et al., 1989). These findings, since they use physical measures of productivity or are concerned with the self-employed, can conceptually be used to counter the

criticism that the returns to education are due to credentialism reflected in money wages in the labor market. However, to the extent that they do not adequately control for unobserved characteristics such as individual motivation and ability, the findings could suffer from the same econometric biases that affect studies of money wages.

Similarly, there is a burgeoning literature on the effects of better health and nutrition on productivity, especially in those activities in which the poor are engaged. While these studies are not used to estimate rates of return as in education (the outcomes are often not valued so as to be comparable to costs), they show the impact on productivity of physical measures of nutrition and health. Several such measures have been used including anthropometric measures (such as height, weight or body mass), mortality or morbidity histories, loss of capacity for normal activities and nutrient intake (in terms of calories). For example, studies of agricultural productivity indicate that an increase in caloric intake results in a substantial increase in the efficiency of an hour of labor among agricultural workers in Sri Lanka, India and Guatemala, as well as among Kenyan road crews (see Behrman, 1990a for citations and a critique). Since a full review of this literature is beyond the scope of this paper, it is informative simply to quote from Behrman's review:

"...though the studies that attempt to control for simultaneity are limited and not without their problems, there is growing evidence of positive effects of health and nutrition on labor productivity of at least poorer individuals in developing countries" (p. 62).

Externalities and human capital. Aside from these direct effects on one's own labor productivity, investments in human capital for one individual can affect the well-being of others also. Some of these external effects can accrue to society as a whole. For example, primary education may foster "good citizenship" in a number of ways -- increasing patriotism, lessening crime or, through literacy, easing the administrative burdens of tax collection. While it is almost impossible to obtain quantitative measures of these general impacts, it is also

difficult to argue that they are not important.<sup>12</sup> There is evidence that, beyond a certain level (fourth grade), schooling leads to a decline in fertility (Cochrane, 1979), although a debate still rages on the effects of lower population growth on economic growth (Birdsall, Chapter 12).

There is more evidence that investments that make one individual more productive can have a positive effect on other individuals. But to what extent should such evidence be used to justify public intervention in the name of externalities? One issue hinges on the answer to the question: "external to whom?" Parental education will influence children's schooling positively. Studies in Malaysia and the Philippines found, for example, mothers' schooling affects daughters' schooling significantly (Behrman, 1990a). A similar argument can be made for health. But systematic evidence outside the family situation has yet to be gathered, so that the issue depends partly on whether benefits that are external to the individual but are internal to the household are important for public policy. This implies addressing some fundamental questions regarding the short-sightedness and altruism of a household with respect to resource allocation among its members.

Another issue is whether all indirect effects should be treated as externalities. There is now more evidence regarding important indirect and non-pecuniary effects of human resource investments. The effects of social sector investments tend to complement each other. Schooling achievement can affect nutrient intake; nutrition depends on the type of food used, which, in turn, depends on the characteristics of the preparer. In Nicaragua, for example, a study shows that the more schooling women have, the better nourished are households (Behrman and Wolfe, 1989). Several studies indicate that schooling has a strong positive effect on health indicators. Mothers' schooling is associated with lower infant mortality, more appropriate weight-for-age of children, greater use of medical facilities such as vaccinations and better household water quality (see Behrman, 1990a for a comprehensive review of these studies). But important

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<sup>12</sup>The magnitude of these non-wage effects can be substantial. Although no aggregate numbers are available in developing countries, in the United States, it has been estimated that these effects amount to up to two fifths of the full economic value of education (Haveman and Wolfe, 1984).

though they are, there is less evidence to what extent such non-monetary effects are truly external to the one directly consuming the service.

A final issue concerns methods of analysis. Just as education can enhance child nutrition, better nutrition improves the child's capacity to learn. Recent studies (for Nepal by Moock and Leslie, 1986 and for China by Jamison, 1986) show, for example, strong correlations between anthropometric indicators of child health and various measures of child schooling achievement. However, these associations need not necessarily imply causality, since it is likely that household decisions about child health and schooling are determined simultaneously. A recent paper (Behrman and Lavy, 1992) examines the nature of the possible biases, which may work in opposite directions. If unobserved characteristics (such as differences in parents' preferences as to their children's attainment at school) lead to greater schooling achievement as well as better child health, there will be an upward bias. But some unobserved characteristics (such as parental concern or local labor market conditions) may lead parents to direct their resources towards enhancing intellectual as opposed to physical outcomes, leading to a downward bias. Behrman and Lavy's conclusion, using data from Ghana, is that these effects tend to offset each other so that, for the range of observed health and achievement measures in their sample, the true effect of health on school success is negligible. It will be important in future studies to examine the robustness of this result given other initial conditions.

Physical infrastructure. Physical infrastructure affects the profitability of private enterprises. Improving it can lower the cost of producing a given level of output or, alternatively, can increase the amount of output produced by all other inputs for a given cost. The benefits of the typical "infrastructural" or "public utilities" project in developing countries embody estimates of these effects (Squire, 1989). Infrastructure also enables markets to work better. Transactions are made less costly and this increases the benefits of trade, both international and domestic. For example, major advances in transport and communications technologies have considerably lowered storage costs by permitting producers to respond rapidly to changing consumer demands in international trade (Peters, 1992, and Kessides, 1993, refer to this as "modern logistics management").

However, despite this widespread application, there are relatively few econometrically-based studies of such effects at the level of firms. The main reason for this is the availability of data. While there is now a reasonably large set of household and individual data from surveys that allow the direct measurement of human capital on earnings, firm-based information in developing countries is only beginning to be made available and utilized by researchers. Where data do exist, researchers have had trouble obtaining access to them because of overzealous attempts to protect confidentiality. Also, most firm-based surveys do not contain adequate infrastructure measures with which to relate to costs and output.

The situation is beginning to change as several researchers are collecting their own data (Lee and Anas, 1992) or are managing to augment firm-level data available from official sources with infrastructure variables. The preliminary evidence from this type of analysis indicates that unit costs tend to rise due to unreliable or inaccessible public infrastructure. Firms, both large and small, spend a significant portion of their expenditure on buying infrastructure services and suffer when these are not available. In Nigeria, for example, unreliable public utilities have led private firms to produce their own infrastructure services at high unit costs as they are unable to take advantage of scale economies (Lee and Anas, 1992). A recent study of small firms in Ghana named electricity outages as among the top four constraints to expansion (Steel and Webster, 1991). In agriculture, infrastructure provision has made a considerable impact in marketing. Transport, for example, can account for about half the costs of marketing agricultural commodities -- an activity that itself accounts for 25-60 percent of the final prices of goods (Beenhakker, 1987). This is reflected in improved prices, the diffusion of technology and the use of appropriate inputs, as was found in a study in Bangladesh (Ahmed and Hossain, 1990), which compared villages that had more developed infrastructure services with those that did not. Rural roads are shown to reduce transaction costs in India (Binswanger et al., 1989), Colombia (cited in Kessides, 1993, p. 27), where they were associated not only with increased production but also greater use of credit and in Thailand (Binswanger, 1983).

These studies are still far from conclusive because they rely on very small sample sizes and do not control for difficult econometric issues, such as simultaneity bias. For example, if improvements in infrastructure are systematically located where firms are most likely to succeed for other reasons, then the estimated effects would be biased upwards.

The impact of infrastructure on poor households can be manifested in the greater income-earning opportunities they can afford. Improvements in firm profitability are likely to induce entry opportunities and enhance employment opportunities in general, although the net effect would depend on the substitutability between labor and physical capital inputs. Improved infrastructure can make it easier for poor households who own their own businesses or who are agricultural producers to make market transactions and to take advantage of profit-making opportunities. However, there is little econometric evidence that has been systematically brought to bear on either of these issues.

There is more micro-level evidence that infrastructure improves social indicators of welfare, particularly among the poor. The direct effect of physical infrastructure on welfare is most obvious in the case of water. The poor can spend large amounts of resources on obtaining water, either through private vendors or, in rural areas, by traveling to water sources (see Kessides, 1993 for citations). As will be seen later, there is often a great deal of willingness to pay for improved services (Briscoe et al., 1993). The use of clean water may have as much to do with social indicators such as infant mortality as access to health clinics (see, for example, World Bank 1993). It is intuitively appealing to suppose that a positive association exists between educational outcomes and the provision of infrastructure, such as electricity in the home, (for example, students in homes with such infrastructure may find it easier to study); however, it has been difficult to obtain strong empirical support for this contention because infrastructure tends to be highly correlated with physical inputs to education such as building quality and the availability of teaching materials (Glewwe and Jacoby, 1993).

Conclusions. Micro-economic studies of the impact of infrastructure on the profitability of firms and household welfare are difficult to undertake in developing countries. One critical issue is the availability of data,



particularly for studies of physical infrastructure and outcomes regarding enterprises. Another issue that affects all studies is one that also afflicts macro-level studies -- simultaneity.

Despite these drawbacks, micro-level studies are better able to demonstrate the link between infrastructure and productivity than those at the country-level. More data exists, except possibly in the case of physical infrastructure. There are also more recent attempts to account for difficult econometric questions by explicitly modeling the source of the possible errors. Applying these techniques tends to confirm the macro-level associations and predictions from theory about the links between infrastructure, productivity and household welfare.

### **3. Public Investment: the Role and Challenges**

In most countries (both developing and developed), governments provide and finance most human and physical infrastructure. Over 90 percent of primary school children and three quarters of secondary school children attend public schools, all of which are heavily subsidized and most of which are free. Almost half of all health spending is attributable to the public sector. It is thus not surprising that central government spending in all of these sectors accounts for an average of about 5 percent of GDP in developing countries (World Bank, 1992a).

The comparable figures for physical infrastructure are more difficult to summarize since the institutional arrangements under which providers operate may not be so clearly delineated as a spending item of the central government. Many services are provided by state-owned enterprises, such as public utilities. However, these enterprises are heavily subsidized, and the evidence that exists

shows that the bulk of infrastructure in most countries is financed by governments (see, for example, World Bank, 1988c, Chapter 8).<sup>13</sup>

Public spending does not give a full picture of the extent of government involvement. Even those infrastructure services that are provided by the private sector are subject to varying degrees of regulatory control, including constraints on the rate of return (particularly for natural monopolies) and on the type of service being delivered (such as curricula in schools -- see, for example, James, 1991).

This section reviews the principles guiding such involvement, the challenges to those principles given the experience of applying them and recent suggestions that have been made to improve the situation.

### The Principles

Economic theory justifies an important role for government intervention in efficient and equitable infrastructure use and provision. The arguments rest on several "traditional" notions of market failure, such as: externalities in consumption and production; scale economies; failures in related markets, like credit (education and physical infrastructure), insurance (health) and labor markets (all sectors); non-excludability; information problems about benefits and costs; and the need to achieve objectives such as equity or poverty alleviation. These standard arguments are well known in the traditional public finance literature and need not be discussed in detail here.<sup>14</sup> But applying them is difficult because infrastructure services are diverse and each exhibits these characteristics to varying degrees.

As discussed in the previous section, empirical research quantifying the importance of these externalities is far from definitive. Thus, the general

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<sup>13</sup>Aside from direct budgetary burdens from non-performing public enterprises, there are also indirect contributions in the form of unpaid taxes and debt service guaranteed by the government. For example, the state power company of The Gambia owed its treasury the equivalent of 16 percent of current government revenue in 1984; its own unpaid claims on the government amounted to one quarter of these arrears (World Bank, 1988c).

<sup>14</sup>For a thorough review of basic principles, see Atkinson and Stiglitz (1980). There are also many treatments of market failures within sectors, such as the classic article by Arrow (1963) for the health field.

principles can only be a rough guide to the appropriateness of government intervention.

Externalities. When one individual's consumption affects the well-being of others, the individual should be induced by public action to consider the social rather than just the private costs and benefit of his or her behavior. In the case of human infrastructure, most of these effects are assumed to be positive, thus requiring intervention by government. These might include general effects on society "at large", such as in eradicating certain types of diseases through mass immunization programs. While there is little solid empirical work on this issue, more evidence is beginning to be marshalled on externalities that affect smaller groups of identifiable individuals. These include the positive impact of schooling and parents' health investments on children's access to these services (which may constitute an externality if parents are myopic or are not altruistic towards their children -- which are important and controversial assumptions, as was already discussed in the previous section).

With physical infrastructure services, negative externalities have been used more in justifying government investment. Congestion and pollution are the most important reasons cited in the literature as to why private markets may not lead to optimal results. In the case of roads, another externality is that associated with damage to users caused by other users (vehicles cause potholes which cause damage to other vehicles -- see Small, et al., 1989).

Scale economies. Some infrastructure investments, especially in physical infrastructure, entail large fixed costs, and this argument is often used to justify natural monopolies which can deliver the service at lower than average costs due to scale effects. Another aspect is the need to integrate service delivery into networks that cover a wide geographic area. An example would be the distribution of hydroelectricity; dams require a large long-term investment and the electricity they generate needs to be distributed over a large area via efficient trunk-feeder lines in order to lower unit costs (Munasinghe and Warford, 1982).

Non-excludability and monitoring use. This is particularly important for physical infrastructure and some health-related programs (such as vector-control activities through spraying). Roads and other transport modes have traditionally

been thought to be too non-exclusionary for a private market to work well, although the setting up of private toll roads in a number of locations has led some to reconsider this proposition (Hau 1990). In the water sector, many argue that it is impossible to monitor all those who benefit from a very large irrigation scheme (see, for example, Repetto, 1986) although beneficiaries of residential water supply can be reached more easily.

Information about benefits. While information needs to be disseminated regarding all infrastructure services, it is widely accepted to be most essential in the case of health. Much of the focus on why health costs are so high has to do with the simple fact that an asymmetry of knowledge exists between consumers and doctors; in other words, consumers cannot be expected to be able to gather enough information to make informed decisions about the kind of health care they need (even this is controversial the patient also has the most information about he or she truly feels). Thus, even in the United States, where consumers are perhaps some of the best informed in the world, lack of information is considered to be the most important reason why a primarily private system fails to provide health care cost-effectively.<sup>15</sup>

Meeting equity and non-economic objectives. Particularly in the case of human infrastructure, governments may have objectives other than narrowly-defined effectiveness and cost-efficiency criteria. One is poverty reduction. Indeed, the provision of infrastructure has been center stage in many of the recent policy pronouncements from international agencies as a way for the poor to enhance their capacity to take advantage of income-earning opportunities.<sup>16</sup> Other possible objectives include investments to promote national security or solidarity.

### The Record Regarding Technical Efficiency

Lately, however, concern about the effectiveness, cost and equity of public intervention has sparked an often spirited debate about the need to temper these market failure arguments with analyses of possible government failure. The

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<sup>15</sup>For work on developing countries on the nature of externalities, see World Bank, 1993.

<sup>16</sup>World Bank, 1990; UNDP, 1991.

rest of this section discusses these concerns. For convenience, it first deals with more narrowly-defined efficiency issues -- in other words, resource allocation under the assumption of distribution neutrality. It then goes on to assess the evidence regarding equity.

Investing in the right type of service. An issue that has received much attention in the policy debate is that the most productive types of infrastructure services are under-provided. Many recent policy studies have argued that investment has not been sufficiently directed towards those infrastructure services that have the highest social rates of return. This is a reflection of both an under-emphasis on relatively inexpensive investments and a lack of government attention to those services that exhibit the most important public good characteristics.

The evidence supporting this point has been more indicative and anecdotal, rather than analytically rigorous. For example, Table 4 shows that, for 24 developing countries, when governments faced tough expenditure choices due to macroeconomic crises, economic infrastructure spending bore a larger burden of fiscal adjustments. These are sectors that have a high ratio of capital to recurrent spending. When countries have had to make difficult spending decisions, they have tended to start by cutting longer-term capital investment. While some of these declines in expenditure on physical infrastructure may be long overdue because of overcapacity or may simply reflect constraints in the capital market, a persistent trend in this direction may begin to compromise long-term growth.

In human resources, Table 4 indicates that, during times of adjustment, governments do try to preserve spending on social services and welfare, at least in relative terms. But many argue that such a trend is hardly an advance -- more resources are needed as demands are increasing. And most important, investment in human resources, particularly in basic education and health, continues to be a high-return but relatively neglected spending category. The World Bank's review of adjustment lending is typical of such criticism, citing, in the case of Brazil:

"...resource concentration at tertiary levels and of declining allocations for basic social services, despite poor social indicators...[The neglect is reflected in a lack of] critical complementary inputs, such as basic drugs, textbooks, and supplies, at the expense of continued overstaffing...Similar problems can be found in many other...countries" (World Bank, 1992c).

**Table 4: Expenditure Trends by Sector for 24 Countries that Experienced Real Declines in Total Expenditure (1979-1989)**

|                      | <i>Percentage change</i> | <i>Elasticity<sup>a/</sup></i> |
|----------------------|--------------------------|--------------------------------|
| Total expenditure    | -17.2                    | 1.00                           |
| General public       | -9.2                     | 0.53                           |
| Defence              | -6.25                    | 0.38                           |
| Social sectors       | -11.4                    | 0.66                           |
| Productive           | -18.7                    | 1.08                           |
| Infrastructure       | -25.4                    | 1.47                           |
| Others <sup>b/</sup> | -1.4                     | 0.08                           |

<sup>a/</sup>: % change in the i<sup>th</sup> sectoral over the % change in total expenditures.

<sup>b/</sup>: Includes interest, transfers to local governments and other non-sector specific expenditures

Source: Hicks (1991)

These anecdotal examples, while dramatic, do not use careful studies comparing the economic costs of misallocations across sectors. As will be discussed below, the methodology for making such comparisons has yet to become a practical reality -- particularly when one is dealing with investments for which benefit calculations are difficult to obtain due to externalities and public good characteristics.

Effectiveness of public spending. A growing literature points out that publicly-provided infrastructure services can be made much more effective in terms of measurable outcomes. The concern is not so much with an inability to produce quantity, as it is with poor quality. The descriptive evidence refers to low achievement scores and high repetition rates in education (Lockheed et al., 1991) and in the lack of drugs in clinics (World Bank,

1987a). In the power sector, it is a lack of system reliability (World Bank, 1992). A recent review indicates that in 85 developing countries, a quarter of the paved roads outside urban areas need reconstruction -- as do a third of the unpaved roads (World Bank, 1988b).

The economic costs of such ineffectiveness can be enormous. The repair bill for the roads in developing countries that need to be reconstructed would amount to \$40-45 billion -- considerably more than the \$12 billion it might have taken in timely preventive measures to keep these roads operational (World Bank, 1988b). In Nigeria, because of persistent breakdowns in publicly-provided infrastructure, 92 percent of surveyed firms owned their own electricity generators (Lee and Anas, 1992). These costs were excessively high because the firms had to invest relatively large fixed costs for small volumes of output (they were also prevented from selling their excess output). Thus, when governments fail to provide reliable services, enterprises can improvise by trying to compensate, but at a larger cost to society.

More rigorous evidence to support the anecdotal evidence on the effectiveness of government intervention is only beginning to be found. One such strand of research indicates that, while the empirical link between infrastructure-related outcome measures (for example, percentage enrollment rates or the availability of road networks) and economic growth is strong, the quantitative evidence on the link between public spending on these infrastructure categories and growth is weak (see, for example, Devarajan et al., 1992). This result could partly be attributed to the difficulty in getting good cross-country data on government spending, or to differences across countries in the cost of infrastructure. More research is warranted to test the robustness of this aggregate result.

High unit costs. Another issue that is symptomatic of inefficiency is that the unit costs of providing the services are too high for a given level of output quantity or quality. One indicator of this comes from comparisons of costs for public and private providers. These comparisons must be carefully done in order to ensure that unit costs are computed at the same levels of quantity (in other words, net of scale effects) and quality.

In human resources, several studies on education estimate the determinants of student achievement and use these calculations to conclude that, with secondary level student characteristics held constant, a randomly-chosen student would perform better in a private school compared to a public school in five developing countries (Jimenez et al., 1992).<sup>17</sup> For the average student, the gains in academic achievement to attending private school rather than public school are shown in column 1 of Table 5. At the same time, unit costs for the private schools are on average lower than those in public schools, due primarily to lower wage bills -- teachers are as effective in private schools, although they are paid less and have lower official teaching qualifications (column 2 of Table 5).

Studies of the relative effectiveness of publicly and privately-provided physical infrastructure tend not to control as carefully for quality and scale effects, making it more difficult to evaluate the unit cost comparisons. Still, the descriptive studies are indicative of the magnitude of the possible discrepancy. In transport, for example, studies indicate that bus transport for intra-city travel is much less costly when in the hands of the private sector (World Bank, 1988c). Private bus companies also tend to have a higher fleet utilization rate, a lower staffing ratio and a lower incidence of fare evasion than their subsidized public counterparts (Armstrong and Thierez, 1987). In the power sector, losses during transmission and distribution (partly through theft) are notoriously high; as a percentage of generation, the losses are 31 percent in Bangladesh, 28 percent in Pakistan and 22 percent in Thailand and the Philippines compared to only 8 percent in the U.S. and 7 percent in Japan (World Bank, 1992a, p. 137). These lead to very high costs.

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<sup>17</sup>Since it is likely that high-performing students come from affluent homes, which provide a more conducive atmosphere for education and self-select themselves into private school, these studies also control for possible sample selection bias via Heckman's two-step technique. The identifying restriction for the equations varies. In the Philippines case study, for example, the relative distance of alternative public and private schools from the household is used to explain the choice of school type but is not used in the achievement equations.



**Table 5: Relative Average Cost and Efficiency of Public and Private Schools**

| <i>Country</i>     | <i>(1)<br/>Ratio of<br/>relative effectiveness</i> | <i>(2)<br/>Ratio of private cost<br/>to public cost</i> | <i>(3)<br/>Ratio of relative cost<br/>to effectiveness/</i> |
|--------------------|--|---|---|
| Colombia           | 1.13   | 0.69  | 0.61  |
| Dominican Republic |  |   |   |
| Non-elite private  | 1.31   | 0.65  | 0.50  |
| Elite private      | 1.47   | 1.46  | 0.99  |
| Philippines b/     |  |   |   |
| Math               | 1.00   | 0.83  | 0.83  |
| English            | 1.18   | 0.83  | 0.70  |
| Pilipino           | 1.02   | 0.83  | 0.82  |
| Tanzania           | 1.16   | 0.69  | 0.59  |
| Thailand           | 2.63   | 0.39  | 0.15  |

a/ Col(2)/Col(1)

b/ Public cost estimates and weighted average of national and local costs. Costs are assumed to be the same for all three subjects and are based on World Bank estimates.

Source: Jimenez et al., 1991.

### **The Record Regarding Equity**

Poverty reduction is often cited as another major justification for government intervention. Equal access to some infrastructure services are particularly crucial as they either alleviate some of the main consequences of being poor (for example, access to health services or clean water has a direct bearing on individual well-being) or they enhance the opportunities for the poor to escape their plight (for example, education enhances future labor productivity).

The record for access to publicly-provided infrastructure services is, at best, a mixed one.<sup>18</sup> In order to review the available evidence adequately, it is first useful to review some of the data and methodologies that analysts have used.

Data needs. The data requirements for incidence analysis can be heavy. The basic need is for a representative sample survey that includes information not only on the level of well-being of the relevant population but also on their use of the infrastructure service under discussion. This means that consumption or household budget surveys that included no data on the use of public facilities would be insufficient. If the analysis were to take into account behavioral concerns as well, then the data requirements would increase accordingly.

Can anything be done without specialized household surveys? One way would be to conduct incidence analysis by sector of economic activity or by geographic region, if it can reasonably be ascertained that certain income groups are concentrated in such sectors or regions.

Methods of estimating benefit incidence. Human and physical infrastructure spending typically accounts for about 5-10 percent of all public spending. The general question addressed in studies of benefit incidence analysis of such expenditures in developing countries is: who benefits from various components of public spending? In particular, how does the receipt of the benefits of public spending vary across groups with different levels of well-being?<sup>19</sup>

The most popular method -- and one employed in the seminal analyses by Meerman (1979) and Selowsky (1979) -- consists of the following steps. First, everyone is ranked by level of well-being -- usually a measure of income or consumption. Second, the average use of the relevant infrastructure service

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<sup>18</sup>This chapter focuses only on infrastructure services, most of which are targeted broadly -- that is, have no explicit mechanism for distinguishing among recipients. The Lipton and Ravallion chapter will deal explicitly with subsidies that are narrowly targeted with explicit selection mechanisms; I will only make brief cross-references here.

<sup>19</sup>There have been several reviews: de Wulf (1975), Jimenez (1986) and Selden and Wasylenko (1991).

for each income or consumption group is then estimated. Third, the cost to the government of providing that service is used as a proxy for the benefit of consuming that service. Fourth, the level of well-being is compared before and after the intervention by adding the assumed benefit level to the pre-intervention welfare measure.

There are several key assumptions in using this methodology. One set of assumptions has to do with how to measure the level of well-being. This issue is well-covered in Lipton and Ravallion's chapter of this volume. Income is probably the most popular measure, despite its obvious drawbacks for developing countries -- some forms of income are hard to value, particularly those of the self-employed and farmers (who are important in less developed countries) and, on top of this, income tends to vary, and not just seasonally. Consumption is probably easier to measure (although it is similarly difficult to make an accurate assessment of spending on items such as housing). Overall, consumption does not vary as much as income and, as such, it is consistent with the utility maximizing model, since consumption is simply the amount of money required to reach a certain level of welfare. A related consideration is which unit of observation to choose, whether household or individual (again, see Lipton and Ravallion). If intra-household distribution is important, then the individual is a more appropriate basis of analysis.

The most complicated set of assumptions revolves around the argument that the public cost of the service is an appropriate proxy for the benefits accruing to the individual who gets initial access to the subsidy. This may not be so for a number of reasons. First, if the beneficiary can resell the access to the subsidy, then the benefits will be shared, depending on the resale price.<sup>20</sup> This is unlikely to be an issue in the case of the services with which we are dealing since it is rather difficult to resell access to infrastructure services.

Second, the benefit to an individual of an in-kind subsidy may not be equivalent to the cash value of purchasing that service. The equivalence

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<sup>20</sup>The analysis will be similar to that in tax incidence work (see Atkinson and Stiglitz, 1980).

holds if the in-kind subsidy can be resold in the open market; it would still hold even if resale were not possible, provided that the consumption of that service after the subsidy is infra-marginal. However, if consumption is not infra-marginal, then the value to the individual of the in-kind subsidy may well be less than that of its cash value to the government. For example, a review of "social housing programs" in the U.S. and Germany demonstrates that the value to beneficiaries ranged from 58-62 percent of the cost of provision (Mayo, 1986).

Third, the benefit of an in-kind infrastructure subsidy may be more or less than the cost of government provision if it precipitates behavioral adjustments by households that would affect the welfare of the recipients. For example, public transfers may substitute, at least in part, for the provision of private transfers. A series of research studies for developing countries shows that private transfers are targeted towards recipients of public subsidies in education and health (Cox and Jimenez, 1990). In fact, a case study for Peru indicates that private transfers would have been about one fifth more had there not been a publicly-funded social security system for old-age support (Cox and Jimenez, 1991).

Finally, there may be a difference between marginal and average benefits. Most incidence analysis is concerned with measuring average benefits. However, what is important for policy prescriptions are marginal benefits -- the benefits of another unit of access. This may be very different for certain income groups. For example, studies indicate that the marginal gain for an additional unit of access to health services, as measured by willingness-to-pay, may decrease for lower income groups (Gertler et al. 1989; Gertler and van der Gaag, 1991).

Results. These considerations are rarely addressed for the majority of incidence studies that have been implemented for developing countries. Nevertheless, with appropriate caveats, these studies using standard assumptions have been found to be useful (see reasons outlined in Selden and Wasylenko, 1991).

Given that the standard methodology is benefit incidence analysis, three important factors will generally determine which services benefit poorer

income groups the most. One factor is the relative costs of different types services. For example, in education, the unit costs is higher education are very much higher than those of other levels. In all developing countries, the opportunity cost of one higher education student is 26 primary school students; in Africa, the ratio is 53:1. In health, present subsidies are also unevenly distributed, partly because urban-based hospital care is much more expensive than other types of intervention (World Bank, 1988c).

A second factor is whether access to these various services is distributed evenly across the population. In most cases, they are not. In education, for example, because only a few people benefit from the large subsidies in higher education, 71 percent of the population gets only 22 percent of the subsidies (World Bank, 1988c).

A third factor is the characteristics of those who do get access. Despite zero prices, there is often a high private cost to access. Materials (drugs), opportunity cost and transport can be a large proportion of private cost even though fees are minimal. When there is supply-side quantity rationing, it often favors the rich. One important reason for this is location -- richer urban households often have better access than poorer rural households to both physical and human infrastructure. Also, there are ways to buy into access. For example, in education, examples abound of private tutoring in order for households to get access to free, high-quality public schools whose quantity is controlled. In health, coverage in those systems covered by formal social security is often better -- but this means that it is open primarily to better-off workers in the formal sector.

Given these considerations, it is thus not surprising that, while the distribution of the benefits of overall public social spending (human and some physical infrastructure) tends to be pro-poor (see, for example, Table 6a and Selden and Wasylenko, 1991), there is considerable variation depending on the type of service one considers. Tables 6b and 6c indicate that basic services, such as primary education and most public health interventions (particularly if they are concentrated in rural areas) tend to be strongly pro-poor. However, the poor are systematically under-represented in terms of their

access to those services that tend to be the most subsidized per unit of service, such as higher education and urban-based hospital care.

**Table 6a: The Impact of Government Subsidies**  
(Education, Health, Social Security, Housing, Water)

|                    | (1980)                                  |                                      |
|--------------------|---|--------------------------------------|
|                    | <i>Income share<br/>without subsidy</i> | <i>Income share<br/>with subsidy</i> |
| Argentina          |   |                                      |
| - Lowest 20%       | 7.1                                     | 10.0                                 |
| - Highest 20%      | 43.7                                    | 39.6                                 |
| Costa Rica         |   |                                      |
| - Lowest 20%       | 5.9                                     | 8.8                                  |
| - Highest 20%      | 47.8                                    | 42.7                                 |
| Chile              |   |                                      |
| - Lowest 20%       | 2.5                                     | 6.6                                  |
| - Highest 20%      | 66.2                                    | 54.4                                 |
| Dominican Republic |   |                                      |
| - Lowest 20%       | 5.1                                     | 6.4                                  |
| - Highest 20%      | 53.3                                    | 50.7                                 |
| Uruguay            |   |                                      |
| - Lowest 20%       | 6.4                                     | 9.0                                  |
| - Highest 20%      | 50.4                                    | 43.8                                 |

Source: Petrei, 1987.

**Table 6b: Benefit Incidence of Various Expenditure Categories**

|                     | <i>Argentina</i> | <i>Costa Rica</i> | <i>Chile</i> | <i>Dominican Republic</i> | <i>Uruguay</i> |
|---------------------|------------------|-------------------|--------------|---------------------------|----------------|
| All education       | +                | +                 | +            | -                         | +              |
| Basic education     | +                | +                 | +            | -                         | +              |
| Secondary education | +                | +                 | +            | -                         | +              |
| High education      | -                | -                 | -            | -                         | -              |
| Health              | +                | +                 | +            | +                         | +              |
| Social security     | -                | -                 | -            | -                         | -              |
| Housing             | +                | -                 | +            | -                         | -              |
| Water               | -                | -                 | -            | -                         | -              |

Source: Petrei, 1987.

**Note:** + = *Contribute to Equality*  
 - = *Contribute to Inequality*

Table 6c. *Who Gets Social Sector Subsidies?*

|                         |                   | Percentage of government subsidy<br>received by income group |                      |                     |
|-------------------------|-------------------|--|----------------------|---------------------|
| Country and sector      | Year of<br>survey | Lower<br>40 percent  | Middle<br>40 percent | Upper<br>20 percent |
| <i>All education</i>    |                   |  |                      |                     |
| Argentina               | 1983              | 48   | 35                   | 17                  |
| Chile                   | 1983              | 48   | 34                   | 17                  |
| Colombia                | 1974              | 40   | 39                   | 21                  |
| Costa Rica              | 1983              | 42   | 38                   | 20                  |
| Dominican Republic      | 1976-77           | 24   | 43                   | 14                  |
| Uruguay                 | 1983              | 52   | 34                   | 14                  |
| Indonesia               | 1978              | 46   | 25 <sup>a</sup>      | 29 <sup>a</sup>     |
| Malaysia                | 1974              | 41   | 41                   | 18                  |
| <i>Higher education</i> |                   |  |                      |                     |
| Argentina               | 1983              | 17   | 45                   | 38                  |
| Chile                   | 1983              | 12   | 34                   | 54                  |
| Colombia                | 1974              | 6  | 35                   | 60                  |
| Costa Rica              | 1983              | 17   | 41                   | 42                  |
| Dominican Republic      | 1976-77           | 2  | 22                   | 76                  |
| Uruguay                 | 1980              | 14   | 52                   | 34                  |
| Indonesia               | 1978              | 7  | 10 <sup>a</sup>      | 83 <sup>a</sup>     |
| Malaysia                | 1974              | 10   | 38                   | 52                  |
| <i>Public health</i>    |                   |  |                      |                     |
| Argentina               | 1980              | 69   | 27                   | 4                   |
| Colombia                | 1974              | 42   | 40                   | 20                  |
| Costa Rica              | 1983              | 49   | 38                   | 13                  |
| Chile                   | 1983              | 51   | 47                   | 11                  |
| Dominican Republic      | 1984              | 57   | 44                   | 9                   |
| Uruguay                 | 1983              | 64   | 25                   | 12                  |
| Indonesia               | 1978              | 19   | 36 <sup>a</sup>      | 45 <sup>b</sup>     |
| Iran                    | 1977              | 51   | 37                   | 13                  |
| Malaysia                | 1974              | 47   | 37                   | 17                  |
| Philippines             | 1975              | 27   | 33                   | 40                  |
| Sri Lanka               | 1978              | 46   | 39                   | 14                  |
| <i>Hospitals</i>        |                   |  |                      |                     |
| Colombia                | 1974              | 23   | 53                   | 23                  |
| Malaysia                | 1974              | 36   | 34                   | 20                  |

<sup>a</sup>/ These figures are for the middle 30 percent.<sup>b</sup>/ These figures are for the upper 30 percent.

Sources: Jimenez (1987), Petrei (1977), World Bank (1986).



There are fewer studies that measure benefit incidence for public enterprises dispensing physical infrastructure (Selden and Wasylenko, 1991). Studies in Malaysia and Colombia have found that the distribution of subsidies for electricity, residential piped water and sewerage services are generally not pro-poor (Meerman, 1979; Selowsky, 1979). These studies emphasize the fact that these services tend to be located in urban areas, where average income is higher than in rural areas. Moreover, within urban areas, there is some clear case study evidence that higher income families have better access than poorer ones in terms of individual physical connections to main lines (Briscoe et al., 1993). Poorer families must thus rely on private water vendors for their water supply and must pay higher unit prices than richer households, as shown in Table 7.<sup>21</sup>

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<sup>21</sup>Private water vendors are those who sell water in the street, mainly in low-income communities. This term does not apply to those who sell bottled water in specialty stores.

**Table 7: Ratio of the Price Charged by Private Water Vendors to the Price Charged by the Public Utility in Selected Cities, mid-1970s to early 1980s**

| <i>City, country</i>   | <i>Price ratio</i> |
|------------------------|--------------------|
| Kampala, Uganda        | 4:1 to 9:1         |
| Lagos, Nigeria         | 4:1 to 10:1        |
| Abidjan, Côte d'Ivoire | 5:1                |
| Lome, Togo             | 7:1 to 10:1        |
| Nairobi, Kenya         | 7:1 to 11:1        |
| Istanbul, Turkey       | 10:1               |
| Dhaka, Bangladesh      | 12:1 to 25:1       |
| Tegucigalpa, Honduras  | 16:1 to 34:1       |
| Lima, Peru             | 17:1               |
| Port-au-Prince, Haiti  | 17:1 to 100:1      |
| Surabaya, Indonesia    | 20:1 to 60:1       |
| Karachi, Pakistan      | 28:1 to 83:1       |

Source: World Bank, 1988c.

#### **Towards Improving Public Investment Policies**

The preceding analysis has identified the following needs:

- across sectors, to set priorities more appropriately by focusing on subsidized public investments in those activities that have the highest marginal returns to public funds and that are used primarily by the poor;
- within sectors, to distinguish among subsectors and apply the same criteria as those governing the choice among sectors;
- to mobilize more resources in a non-distortionary way;
- to improve management and internal efficiency; and
- to improve targeting to the poor.

If followed, these actions will lead to socially efficient policies, as they are roughly equivalent to taking into account appropriate shadow prices. But meaningful and sustainable policy reform must investigate more deeply into the root causes of policy failure -- what led to the present unsatisfactory outcomes and what reforms can be instituted to correct for them?

An extensive inquiry is beyond the scope of this paper, but it is useful to focus on several general reasons that have preoccupied analysts trying to improve investment policy in infrastructure. There appears to be a general consensus that investing more money in much the same way as before will not solve the problems and that, therefore, appropriate policy reform is the key. If so, one must understand the policymakers -- their abilities, the information and techniques available to them and their incentives. The rest of this section reviews some recent work addressing some of these parameters, including developing better tools of analysis, fostering institutional reform that increases efficiency, such as decentralization and greater private sector involvement, and taking political economy into account in analyzing infrastructure investment.

Better tools of analysis. One important area is to develop more practical tools of analysis or guidelines for allocating resources across spending categories -- that is, choosing among spending alternatives by weighing benefits and costs through an analysis of their social rates of return. This is often a problem because the tools for doing so for both human and physical infrastructure are far from perfect.

Formal cost-benefit exercises are often not used to evaluate investments in human infrastructure.<sup>22</sup> One reason may be that it is often difficult to evaluate benefits for many human resource investments. In education, although there are a growing number of studies that estimate the rate of return to different levels of education (see Table 1), they are not available for many countries, are of variable quality and generally ignore some high cost-

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<sup>22</sup>For example, the World Bank's operational guidelines for the economic analysis of projects acknowledge that, "while it may be possible to use quantitative criteria in such [social] sectors more often than is customary, both conceptual and statistical difficulties limit their application". (The World Bank, 1980, OMS 2.21 "Economic Analysis of Projects".)

services, such as alternative disciplines in higher education. Moreover, as discussed earlier, most of the benefit estimates (which are typically inferred from wage differentials) are unable to take into account such difficulties as externalities or quality effects. On the health side, rates of return are only very rarely computed because evaluating benefits requires explicit calculations of the value of life (or healthy life-years). The methodological difficulty of doing this have forced analysts to conduct instead cost-effective analyses that allow only limited inter-sectoral comparisons of spending options.

Because of these factors, combined with the misleading but lingering view that "social" services cannot inherently be compared with "productive" services, rate-of-return comparisons are not used to guide investment decisions in the social sectors. This view has recently been challenged by those who claim that rates of return can indeed be computed for education and health services (Psacharopoulos, 1985) and that, in any case, the pitfalls in deriving benefit estimates for these services are no worse than those that plague physical infrastructure.

Another possible reason why cost-benefit methodology is not so widely used as a planning tool is that the most important spending decisions in human resources are not about discrete capital investments but about more continuous flows of recurrent spending. In theory, the techniques can be adapted to evaluate recurrent spending, a larger component in social expenditures than in infrastructure expenditures, which are heavily weighted by new investments (see Besley 1989b for suggestions on how to make such concerns operational). In practice, implementation is more difficult because data on recurrent spending categories are often not neatly subdivided in a way that is relevant for policy -- for example, the joint costs of producing various levels of education and health expenditures are difficult to sort out. Thus, the need to develop practical economically-oriented guidance on inter-sectoral spending choices remains a priority item on the conceptual agenda. Even in the absence of hard data, however, the discipline of going through steps of benefit-cost calculation in making broad sectoral allocations can help to make the logic of spending decisions more transparent and explicit.

In the case of physical infrastructure, rate of return analysis has a well-established methodology and a long accepted tradition in development (see Dreze and Stern, 1991 and Squire, 1989 for recent comprehensive treatments of the concepts). But a recent review by Little and Mirrlees (1990) indicates that the analytical principles are not being applied systematically:

"We have claimed that much in the rules [about cost-benefit analysis] we collected and prescribed in 1969 and 1974 has survived analytical scrutiny, that these procedures are capable of being used effectively, and that many important aspects of them have been neglected by project evaluators. We have found that the extent to which they are used and have real influence is not great... (p. 376).

The authors then suggest that this is one reason why investment in developing countries has had very low returns in the aggregate, leading to low growth during the 1980s.<sup>23</sup>

The question is, how can this process be improved? At issue is the complexity of the methods, as well as the incentives of the institutions to take them seriously. Squire (1991) suggests the following practical principles: (i) basing project costs on historical experience (rather than on overly optimistic projections), (ii) using shadow pricing, but only when it is critical (that is, for those projects whose profitability is highly sensitive to the choice of the standard conversion factor) and (iii) explicitly building in analyses for cost recovery to those projects that result in a net cost to the public sector but a net benefit overall.

Another methodological issue is that conventionally-estimated rates of return may be an inadequate guide to investment choice in the absence of an analysis of the general economic environment in which the project is operating. Table 8 depicts how rates of return to public projects -- particularly those in infrastructure -- vary with various indices of market distortions resulting from trade restrictions, exchange rate interventions, the real rate of interest and the public deficit. Fewer distortions are

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<sup>23</sup>However, they do note that World Bank projects tended to have relatively high rates of return. But the rest of the investment portfolio for these countries did not fare as well -- which raises the important issue of fungibility.

highly correlated with greater rates of return.<sup>24</sup> While these calculations are based only on World Bank projects, they are from an extensive database of 1,200 projects over a 20-year period (Kaufmann, 1991). A similar study on the success of human resource projects (measured by ex-post evaluation rankings rather than by rates of return, which are not calculated) finds similar results (Kaufmann and Wang, 1992).

**Table 8: Economic Policies and Average Economic Rates of Return for Projects  
Financed by the World Bank and the IFC, 1968-89 (1%)**

| <i>Policy distortion index</i>     | <i>All public projects</i> | <i>Public projects in non-tradable sectors</i> |
|------------------------------------|----------------------------|--|
| <i>Trade restrictiveness</i>       |                            |  |
| High                               | 13.6                       | 14.6   |
| Moderate                           | 15.4                       | 16.0   |
| Low                                | 19.3                       | 24.3   |
| <i>Foreign exchange premium</i>    |                            |  |
| High (200 or more)                 | 7.2                        | 11.5   |
| Moderate (20-200)                  | 14.9                       | 17.2   |
| Low (less than 20)                 | 18.0                       | 19.3   |
| <i>Real interest rate</i>          |                            |  |
| Negative                           | 15.4                       | 17.9   |
| Positive                           | 17.5                       | 17.9   |
| <i>Fiscal deficit<sup>a/</sup></i> |                            |  |
| High (8 or more)                   | 13.7                       | 16.6   |
| Moderate (4-8)                     | 15.1                       | 16.8   |
| Low (less than 4)                  | 18.1                       | 18.2   |

<sup>a/</sup> Percentage of GDP.

Source: Kaufmann 1991.

<sup>24</sup>It is not possible to infer causality strictly because of a possible source of bias in the comparisons if the observed policy distortions are caused by the same factors (say, political economy) that affect the rates of return.

The problem of inter-sectoral resource allocation can be approached using the modern theory of optimal taxation (Besley, 1989a is an example of this).<sup>25</sup> The problem would be to derive a set of optimal subsidies, which can be interpreted simply as negative taxes. Given costs, these would imply a set of optimal prices for all public services. These would presumably depend upon the relative elasticities of demand for the range of goods and services. If, for example, demand for transport services were more inelastic than that for some health service, then cross-subsidies from transport to health might be in order. Contingent on the continued growth of a literature on the price elasticities of different public services, this could be a promising avenue for future research, although implementation could be constrained by heavy data requirements.

Providing better incentives through less centralized institutions.

Public sector management is partly a question of applying a range of techniques from budgeting to personnel administration. These techniques are obviously important factors in improving investment performance, and it is important for staff to receive adequate training and technical assistance. However, these are issues that are not germane to infrastructure and are not treated any further here. Public management is also a question of building incentives within institutions where objectives may not be clear and competitive pressures may not exist, leading to a lack of accountability and undermotivated workers. Many have argued that, in order to address such incentive issues within government, more than a piecemeal reform of public administration will be necessary. In this regard, two initiatives have received much attention lately in the field of infrastructure -- decentralization and privatization.

The debate about decentralization ranges over a wide set of issues regarding the appropriate balance of financial and administrative responsibility among central governments, sub-national (state and local)

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<sup>25</sup>See also the discussion in Atkinson and Stiglitz, 1980 or Stern, 1987 for a full discussion of optimal public pricing and how the principles are similar to those of the optimal taxation literature.

governments and the institutions and communities themselves.<sup>26</sup> It is an issue that is particularly important for human infrastructure where the provision and financing of infrastructure services has traditionally been very heavily centralized (Winkler, 1991; World Bank, 1993). The issue is whether more decentralization would be desirable on efficiency grounds. There are two principal arguments. One is largely technical. The scale economies in providing infrastructure services may be overestimated, once administrative and information costs are taken into account. For example, when even small questions have to be referred to central authorities (such as individual curricula in schools), unit costs tend to be very high. Also, central authorities may have less information than those who run the facilities leading to misallocation regarding input mixes. The other argument is incentive based -- centralized institutions, compared to local institutions, are not as accountable to those they serve, precisely because the client group is not the funding source.

While there are not yet many empirical studies, the initial evidence tends to support these propositions. A study by Jimenez and Paqueo (1993) indicates that, in the Philippines, unit costs in schools where parents contribute more to financing tend to be lower than other schools when quality is held constant. A similar finding is reported by James et al. (1993) for Indonesia.

Implementing decentralization reform is also an important issue. Reforms to decentralize health care provision and education in Chile have been generally successful in delivering more services to where they are needed, but the implementation process has been more difficult and slower than anticipated. Getting local authorities prepared for taking on a different role takes time and effort (Castaneda, 1992).

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<sup>26</sup>In a world of many communities, each with a different tax and package of public infrastructure (as well as other services), if people are perfectly mobile, an optimal allocation of public goods will result. In this Tiebout-world, consumers reveal their preferences by moving, yielding an efficient market-like solution. But inter-jurisdictional spillovers and moving costs imply that higher tiers of government may have to intervene in such a world, taking into account these externalities and scale economies in service provision.



By contrast to human infrastructure, physical infrastructure services tend to be provided by semi-autonomous, state-owned enterprises or by line units of municipalities and other sub-national agencies. This can lead to principal-agent type issues about the ability of the central government (the principal) to affect the behavior of the provider of the service (the agent) when the two actors may have different objectives and information bases. One example would be if the central government is interested in a provider being an employer of large scale while the agent is trying to minimize costs (see Galenson, 1989 for the case of roads). However, there have been few studies that have posed the problem in this way in infrastructure and none that have addressed it empirically.

A more extensive discussion has emerged regarding privatization and how it can improve incentives in physical infrastructure. The argument is that, in many cases, the public sector has taken on more than it should -- after all, the market failures described above probably do not apply to the same degree for every infrastructure service. Indeed, in the early years of many industrial countries, basic infrastructure -- such as roads, railways, power and even education -- was financed and built mainly by private entrepreneurs and organizations (Roth, 1988). Disengaging the public sector in situations where its role as a provider is not justified would allow (a) a private sector that is more subject to competitive pressures to provide the services more efficiently; and (b) the public sector to focus its limited financial and administrative capacity on those services where market failures are indeed important and public provision in some form is required. There are issues associated with each point.

For what types of infrastructure services would a greater private sector involvement be viable and efficient? It is important to distinguish among various types of services, and within services, types of activities, because they have different characteristics. Some infrastructure services, for example, are not subject to scale economies and are more easily characterized by perfect competition, such as trucking and bus services. Private provision is likely to lead to efficiency gains in this case, unless there are barriers to entry due to regulatory restraints. The evidence on this point has so far

only been illustrative and relies on simply comparing the unit costs of public and private providers of a given service to infer what the efficiency gains might be from privatization, without rigorous controls to ensure strict comparability. For example, data for urban transport show that, in cities where bus services are provided by both public and private operators, the cost per passenger is lower for private operators than for public operators, despite the fact that the public services are invariably highly subsidized. For these same cities, the public operators have a lower fleet utilization rate, a higher staffing ratio and a greater incidence of fare evasion than unsubsidized private operators.

Ratio of per passenger private cost to public  
cost of comparable bus services, 1985

|          |     |          |     |
|----------|-----|----------|-----|
| Ankara   | .48 | Jakarta  | .50 |
| Bangkok  | .63 | Karachi  | .36 |
| Calcutta | .37 | Khartoum | .40 |
| Istanbul | .85 |          |     |

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Source: World Bank, 1988c, calculated from Table 6.3

Recent case studies on roads have found that the unit cost of road maintenance done directly by government agencies is about 60 percent higher than that of work done by private contractors in Brazil (World Bank, 1988b). Such cost comparisons need to be done more carefully, however, to ensure that all the components of cost are taken into account even for the private sector.

But for many infrastructure services, there are barriers to entry (either regulatory or technological) as well as scale economies that inhibit a large number of private firms from operating profitably. Thus, it is important to consider the market structure that results from a privatization effort, since a regulated private monopoly is not necessarily more efficient than a well-run, publicly-owned utility.<sup>27</sup>

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<sup>27</sup>For example, prior to its break-up in 1983, the Bell telephone system in the U.S. provided excellent service (and returns to its investors) but it was needlessly expensive. The company was able to justify high local rates by adding to its cost base. (When broken up, Bell quickly shed many of its prestigious but not directly profitable operations, including its theoretically-inclined economic research staff and academic economics journal.) Such a monopoly puts a heavy

A useful framework for discussing this question is contestability analysis, under which competitive pressures can result from potential as well as actual current rivals. Thus, unlike perfect competition, it is compatible with the presence of scale economies and, consequently, a small number of large firms subject to the threat of entry.<sup>28</sup> Even monopolists in a perfectly contestable market cannot earn excessive profits since these would be a profit opportunity for potential entrant. The key is free entry and exit into the market.

This analysis has been applied to the case of infrastructural deficiencies in Nigeria, where a public sector utility such as the electric power authority is often characterized by severe shortcomings in operation and maintenance, as well as in administrative and financial management. Baumol and Lee (1991) conclude that the most promising way to correct these inefficiencies is to institute regulatory changes that would allow greater participation of the private sector -- such as allowing private firms to sell any excess power to the public agency or to other firms to make the electric utility market more nearly contestable. Scale economies would allow these private firms, which already have generating capacity because of unreliable public supplies, to lower their costs. Another regulatory change would be to let industrial areas to manage "utility pools", not only for power but also for other public services, such as water supply, garbage collection and telecommunications.

In such analyses, unbundling activities within sectors is an important concern, since the market for some activities may be more contestable than others. For example, in power, even though natural monopolies exist in the transmission and distribution of electricity, generation can be done by small producers, who can sell it to consumers through public utilities. In

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burden on the regulatory authorities to monitor the firm closely and to develop innovative incentive schemes -- a difficult task, particularly in developing countries.

<sup>28</sup>Baumol and Lee (1991) provide a very useful primer, with an application for infrastructure services in developing countries. For a more comprehensive treatment, see Baumol, Panzar, and Willig (1988).

addition, services that used to be done by public agencies are now being contracted out, such as stevedoring in Chile or the sale of railway tickets in Korea. In Côte d'Ivoire, the public authority in charge of water supply is responsible for owning and financing the fixed assets while a private company is responsible for operations and maintenance. Contracting out is also being tried in education, as in Chile and also in the Philippines where there was exploratory scheme to allow the public school enrollment surplus to be educated in private schools for a fee (World Bank, 1989). Rigorous evaluation summarizing the lessons learned from these schemes have yet to be conducted.

Even when these services are provided privately, the government still has a role, for example, in ensuring that acceptable safety and environmental standards are met and that the poor have access to certain key services. It would be important to consider efficiency criteria in meeting such objectives (see, for example, Eskeland and Jimenez, 1993, on the choice of policy instruments in pollution control and Lipton and Ravallion's chapter in this volume and Grosh, 1993, on targeting public expenditures towards the poor). Also, the emphasis on away from almost universal direct provision towards selective intervention in (and effective regulation of) certain activities entails a fundamental way in which many governments do business. For example, regulatory interventions must ensure that they do not themselves become barriers to entry for private sector involvement. One major impediment to direct private sector investment is the risk that future price controls or government interventions will reduce the returns to that investment. Another barrier is most governments' underdeveloped capacity to design, award and supervise contracts that assure equitable risk sharing and good performance. A promising initiative in public-private partnership in infrastructure is to operate on a "build-operate-and-transfer" (BOT) or "build-own-and-operate" (BOO) basis, under which a private firm finances some or all of the initial investment and is remunerated directly from revenues earned by the project by selling the facility or output to a public utility. An example of this is a recent scheme in Pakistan in which eight power generation projects, joint ventures by consortia of domestic and foreign contractors and worth about \$2 billion, were packaged, including provisions for the repatriation of profits

and guaranteed purchase and price agreements between the power generators and the national utilities. BOT schemes provide for the eventual transfer of ownership to the state, when private firms do not want to assume the risks and liability of operating the facility. A recent survey indicates that since the early 1980s, almost BOT-type infrastructure projects have been funded worldwide at cost of over \$60 billion (World Bank, 1994).

Whether the private sector or local communities respond to this challenge will depend upon local organizational abilities, as well as on the risks they face if they do not respond. A case study of 31 villages in upland South India suggests that, where the risks of crop loss and conflict caused by water shortage are high, villages tended to organize local infrastructure at little cost, ignoring the officially-established local government in the process (Wade, 1988).

Political economy. There are several issues of political economy that can affect infrastructure investment. One is that some infrastructure investment is undertaken for non-economic reasons, such as national security (transport) or national unity (education). These must be taken into account in the process of planning infrastructure investment.

Another issue is that infrastructure, like most other public spending, is subject to "capture" by special interest groups. In human resources, this phenomenon has been blamed for the fact that public investment places such a heavy emphasis on tertiary levels (universities and urban-based hospital care) as opposed to primary levels (basic education and health care), even when the latter have higher rates of return and are more equitably distributed (Birdsall and James, 1993, forthcoming). This has been attributed to the power of urban dwellers to exercise more influence over resource allocation.

Political economy can also be at the root of the problem of quality, which is linked to underinvestment in operations and maintenance (O&M), particularly in spending on non-wage categories. As pointed out by Heller (1976, 1992), governments tend:

"...to concentrate their efforts on new investments and failure to provide adequately for the recurrent costs of operating and maintaining previous projects. Sectors in which there have been the largest shortfalls in O&M are, typically, road networks, public and government

buildings, agricultural equipment, and communications equipment." (Heller, 1992, p. 52.)

One problem is that the incentives of various decision-makers are often biased. Large economic rents in new construction lead to a coincidence of interests among beneficiary groups, the politicians they lobby and, finally, bureaucrats from infrastructure agencies, all of whom may benefit more from starting new projects rather than maintaining old ones. The resulting decision-making process leads to large suboptimal investments, even in developed countries. In the United States, for example, the value of irrigated water to some 146,000 farms served by the Bureau of Reclamation amounted to nearly \$15 billion or 56 percent of the average market value of irrigated land. The 6 percent of all farmers who receive the subsidy are among the richest in the nation (Repetto, 1986).

In some infrastructure services, particularly in the area of human capital, the problem is not so much excessive new investment as underinvestment in the non-wage component of O&M. Strong labor market actions by education and health care workers often lead to protection of wage payments when budgets become tighter. In Côte d'Ivoire, for example, the proportion of the budget devoted to the wage bill went up, while the proportion going on materials fell between 1975 and 1986. Over that period, the results were a lack of teaching materials and drugs, dilapidated and unsanitary conditions and an overall decline in quality that seriously undermined productivity (World Bank, 1992c).

#### 4. Pricing Infrastructure Services

Recently, international institutions have been advocating pricing reform in public infrastructure as another way to address many of the issues outlined

in the previous section.<sup>29</sup> From given low levels, raising prices can mobilize revenue that can be used to increase the accessibility and improve the quality of services. At the same time, demand management will reduce waste. If done selectively so that prices for services consumed by the rich are raised, there could even be a salutary effect on equity.

This section first reviews some basic principles of public pricing, before discussing the recent issues in human and physical infrastructure.

### Some Basic Principles

The basic principles for public pricing are well established in public finance (see Atkinson and Stiglitz 1980). Efficiency requires prices to be set according to social marginal cost. When there are no externalities, market imperfections or other distortions, and when goods and services are traded freely in the private market, the appropriate reference point would be the prevailing price. For goods that are not traded privately, such as most infrastructure services, the incremental opportunity cost of resources used in production must be considered. In these cases, the public authority must also take into account: (i) externalities (whether positive, such as decreasing the incidence of communicable diseases through a health project, or negative, such as the increased pollution caused by the increase in traffic induced by a new road); (ii) scale economies, caused by large fixed costs which, in turn, imply that marginal cost pricing cannot recover costs; (iii) incomplete markets (such as underdeveloped financial credit markets for education or insurance markets for health); and (iv) the administrative costs of collecting certain kinds of charges (such as monitoring volumes of water used by a large number of users or being able to exclude nonpayers). In addition, prices may take into account distributional and financial objectives. The main issues in

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<sup>29</sup>Publications by the World Bank on the following sectors all contain these points: health (World Bank, 1987); water (World Bank, 1992, forthcoming); energy and power (World Bank, 1992b); roads (Heggie, 1991); education (World Bank, 1986).

practice arise in how those principles are applied in specific sectors.<sup>30</sup>

Another consideration that has more recently been considered in the pricing literature is the fiscal context. While the fiscal crises of the 1980s which confronted many developing country governments drew attention to this issue, the principles behind the approach were more general and rigorously rooted in ideas developed in modern public finance.<sup>31</sup> Public pricing decisions need to take into account the overall budget constraint since alternative forms of raising revenues through taxes on commodities, trade, or labor would inevitably introduce distortions elsewhere in the economy. Distortion-free lump-sum taxes are infeasible and there are economic limits to which governments can rely on the inflation tax (which may introduce its own distortions) and increasing the deficit. Prices charged by public enterprises can thus be an efficient alternative in raising revenues. The result is that governments may provide a lower subsidy for services for which there are large externalities, once the fiscal objective is considered. Indeed, prices may generally exceed the marginal costs as conventionally calculated.

If one were to assume that the profits and losses of the public agency (or state-owned enterprise) delivering the infrastructure service were simply passed on to the central government, then, the analytical problem of deriving optimal prices would be analytically the same as that of setting optimal taxes. It is beyond the scope of this paper to derive these formulas, which are discussed more fully elsewhere (see the references in footnote 30). This approach is very data intensive. Even under the strong assumption that prices elsewhere in the economy are constant (if they were not, addressing this fully would require a computable general equilibrium model), the estimates of fiscal

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<sup>30</sup>A recent review of infrastructure pricing at the World Bank (Julius and Alicbusan 1988) indicated that while it is standard policy to compute marginal cost and explicitly adjust it to take those considerations into account, many of the adjustments are not done in practice.

<sup>31</sup>The classic reference is Diamond and Mirrlees (1971). Treatments in the tradition of the recent public finance literature, see Atkinson and Stiglitz (1980). For applications in some of the sectors of concern in this paper, see Katz (1987), Besley (1989b), Hammer (1993), and Heady (1988).



gains would require a calculation of the change in demand of the service in question as well as the cross-price elasticities of other services that serve as substitutes and complements. Estimating the distortionary cost or "excess burden" would require similar data (although one would want the compensated demands of the relevant goods).

These ideas have been applied in a much more simplified way to the more limited (and arguably short-term) problem of setting prices within a sector or service (as opposed to setting prices optimally over the full range of government services), when the subsidy required is less than what is optimal. The partial equilibrium diagram of Figure 1 illustrates some of the basic arguments. Let  $D_p$  and  $D_s$  denote private and social demand curves.  $D_s$  is to the right of  $D_p$  because of externalities. The optimal quantity of the service,  $q^*$ , will only be consumed with an optimal unit subsidy equivalent to  $s^* = c - p^*$ , where  $c$  depicts marginal cost (assumed to be constant without loss of generality) and  $p^*$  indicates the private cost to the individual, who must then pay a fee equivalent to  $p^* - c_p$ , the private costs of going to school. This means that total subsidy is  $S_0 = S^* = cq^*$ . When do these arguments justify a zero price, the most popular option for many social services? The optimal fee is zero only if the marginal private benefit curve crosses  $c_p$  at  $q^*$ , or if the administrative costs of collecting the fee (not drawn) outweigh the benefits.

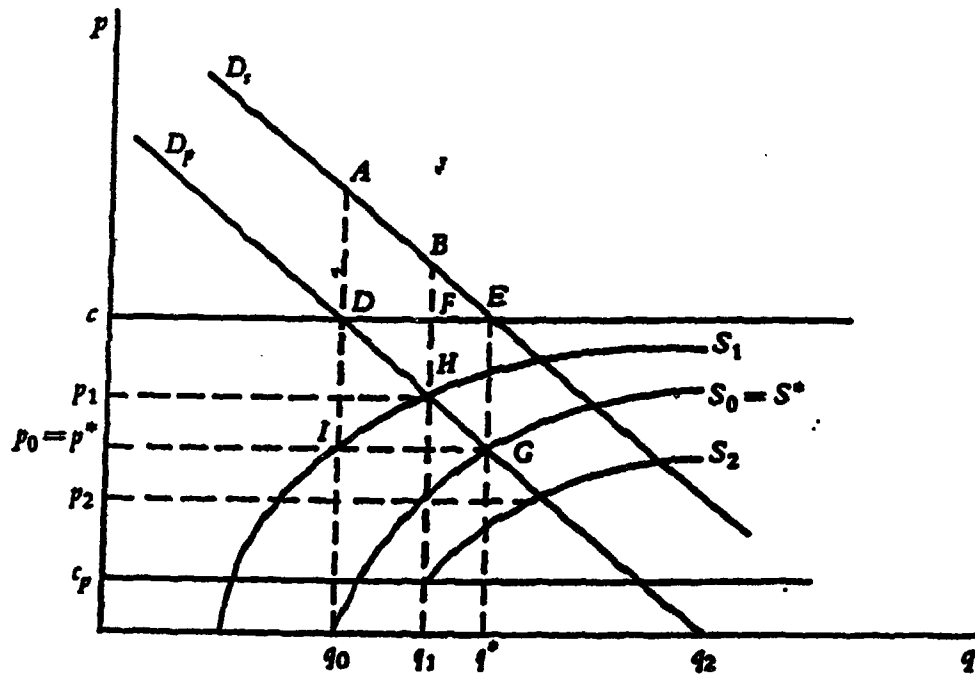
[Figure 1 about here]

What happens when there are budgetary restraints?<sup>32</sup> Second-best principles apply. The government is restricted to financing the cost of providing a public service,  $cq$ , out of a given subsidy budget,  $S_1$  and the proceeds from a user charge,  $pq$ . Then, the iso-subsidy locus, which shows the combinations of  $q$  and  $p$  that would be consistent with a given unit cost of provision  $c$  and a budget  $S_1$ , is in effect the supply curve. The optimal subsidy in Figure 1 is  $S_0$ , but the optimum is not available in this case. The distance between the locus and the constant marginal cost of providing the

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<sup>32</sup>See Thobani (1983), Jimenez (1987), Besley (1989b) and Katz (1987) for more thorough discussions of these models.

**Figure 1. Pricing Policies under Budgetary Constraints**



service is the amount that needs to be "recovered" from the users. Given the binding budget constraint<sup>33</sup>, at a price  $p_0$ , there would be excess demand equivalent to  $q_0 - q^*$ . A unit price increase of  $c - p_1$  would be welfare improving by the amount of the area ADFB. Essentially, the intuitive rule in this case would be to raise fees until the excess demand disappears.

The rest of this section discusses the extent to which these ideas have been applied to human and physical infrastructure in theory and in practice.

### Human Infrastructure<sup>34</sup>

Over the past 10 years, the concept of pricing education and health has once more come to the fore as a means to address some of the efficiency and equity issues outlined in Section 3. It is here that the proposed changes have been most different from past practice and advice.

Past practice and suggested reforms. The majority of education and health services in developing countries are provided by central governments. These services are very heavily subsidized, to the extent that they are usually provided free, or almost free.<sup>35</sup> In addition, there are often restrictions on the level of fees that private providers can charge users.

While it is difficult to get an accurate measure of the share of recurrent costs recovered through user charges (because definitions and categories of budgetary flows are not systematically monitored internationally), Table 9 provides rough estimates for a sample of countries. The cost figures do not account for the possibility of distorted prices, but the data are indicative and show that there is some variation across countries but that overall the shares are generally very low.

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<sup>33</sup>The budget constraint would not be binding if  $S_0$  were to cross the private demand curve beyond  $q^*$ .

<sup>34</sup>Many of the ideas in this chapter are taken from Jimenez (1987, 1990). However, this chapter provides a conceptual and empirical update.

<sup>35</sup>While systematic evidence on the amount of public expenditures that is recovered is not available, there is much country-specific evidence that the most popular pricing scheme is zero-pricing, at least officially (see, for example, World Bank, 1986, 1987a). This does not include "unofficial" prices charged by providers for access to rationed services.

**Table 9: Cost-Recovery Ratios in Education in Developing Countries, early 1980s**

|                       | <i>% of countries<br/>with no fees</i> | <i>Uses fees as<br/>% of unit cost</i> | <i>Number of<br/>countries</i> |
|-----------------------|--|--|--------------------------------|
| Education             |  |  |                                |
| Primary               | 39                                     | 8                                      | 36                             |
| Secondary             | 25                                     | 15                                     | 36                             |
| Higher                | 30                                     | 8                                      | 30                             |
| Health <sup>a</sup> / | n.a                                    | 7                                      | 17                             |

*Source: Jimenez, 1987.*

<sup>a</sup>/ % of recurrent public health expenditure covered by user fees

*n.a = not available*

Recent studies, many sponsored by multilateral financial institutions like the World Bank (for summaries of this debate, see World Bank, 1986, 1987a; Jimenez, 1990; and Creese, 1992) have argued that present pricing rules ought to be changed to improve efficiency and equity. In particular, the literature focuses on three points. First, despite evidence that more investment in education and health is still profitable, there are severe constraints to tapping further central government sources. Second, uniformly low prices mean that expensive services are subsidized more than cheaper ones, which leads to the poorest having little access to subsidies. Third, the limited resources devoted to social services are often badly used. While the exact recommendations vary, the common link among them is the idea that policies that differentiate prices by type of service and by type of consumer are generally more efficient and equitable than low and uniform price policies. The rest of this section reviews the conceptual arguments and the empirical evidence regarding this proposition.

The principal recommendations have been debated in the past eight to ten years, in both the research and policy literature.<sup>36</sup> They include the following:

- o Increase prices for some social services that have large private benefits and are consumed by the relatively well-off. For many countries, these services include higher education or curative care in urban hospitals. The extent of the increases will have to be tailored to the availability of credit (for education) and insurance (for health) markets.
- o Invest revenues in socially-profitable services, focusing on expanding quantity (such as primary education, primary health care) or on quality (such as non-wage recurrent expenditure categories).
- o Protect the poor's consumption of the services, with increased prices through categorical targeting or, where feasible, means testing.
- o Make institutional changes to develop credit and insurance markets, particularly in education and health respectively, as well as to liberalize overly-centralized provision, thus giving institutions, local communities and private providers more responsibility.

Efficiency: some conceptual issues. What are the efficiency justifications for these proposals? One argument is that the reasons for heavily-subsidized (and, in some cases, free) provision are not warranted for all types of social services. Externalities, for example, may hold more for primary education and less for higher education (World Bank, 1986). Similarly, the benefits of curative health care and a clean water supply are particularly considered to be private, whereas those of preventive care could have external benefits. The empirical evidence offered in the literature on these issues, already been reviewed earlier, is still relatively limited,

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<sup>36</sup>See, for example, World Bank (1986, 1987a), de Ferranti (1985), Jimenez (1986b, 1987), Griffin (1987) and Briscoe (1993). For examples of dissenting views, see Abel-Smith (1987), Bray (1986), Gilson (1988).

which is surprising given the central role that the argument currently plays in shaping policy.

Information about benefits is particularly important for health. The asymmetry of information between provider and user has long been recognized as one of the most important roadblocks to relying only on private insurance as a cost-efficient system. Profit-maximizing providers could have a moral hazard problem in prescribing high-cost treatments. In this case, subsidizing provision could be important for users. However, subsidies alone will not solve the problem and could exacerbate it if providers know users have access to the "deep pockets" of government. There is more of an argument for increasing regulation or for eliminating the moral hazard problem through pre-payment arrangements in which both the provider and consumer have a stake in keeping the latter healthy (health maintenance organizations are motivated by this principle).

Another argument for reconsidering pricing options in the social sectors is fiscal -- for a variety of reasons, budgets are severely restrained, even though the returns to some investments are high. There are several reasons for this outcome that have been discussed earlier. For example, the costs of mobilizing revenues through general taxes are particularly high in developing countries because of their heavy reliance on distortionary indirect domestic and trade taxes (World Bank, 1991b; Newbery and Stern, 1987). Also, central governments fail to allocate sufficient amounts from the main treasury because of technical constraints (such as the failure to measure benefits and costs of social programs accurately in order to make the appropriate investment choices) or because of political roadblocks (see Birdsall and James, 1993).

But the welfare improvement from a fee increase is dependent not only on demand-side parameters, but also on the supply responsiveness of providers. The foregoing analysis assumes that increased prices will finance service expansion. Thus, in evaluating the welfare implications, it is also important to capture supply responses. This is true not only for quantity but also for quality, which is often sacrificed in a budget-restrained environment. Some analysts have argued that fee revenues can be earmarked for certain non-wage

operations and maintenance spending since this is where government tends to underspend (Heller, 1976).

What evidence is there that these effects are important? The ultimate objective of policy reform is to maximize social welfare. However, this is too general to be useful as an operational criterion for making an empirical evaluation of policy change. The literature has instead focused on various arguments for pricing reform -- namely that increasing prices will:

(a) increase government revenues, which can be used to expand the supply and quality of priority services; (b) stimulate the use and consumption of those services; and (c) improve key indicators, such as gains in consumer surplus or by direct measure of health and educational outcomes, such as health status or literacy (although attribution may be difficult due to lags between policy changes and expected impacts).

The growing literature on price effects in the use of education and health are of roughly two types: (i) studies that primarily simulate the revenue, supply, use and welfare effects and (ii) those that attempt to monitor the impact of actual attempts to raise prices. Both types of evaluations are reviewed here.

Efficiency: evidence from simulation studies. Some policy studies have simply used some rough order of magnitude to get a sense of what kinds of financing can be generated if demand were completely inelastic and a price increase were used to finance service expansion. The results can be dramatic. For example, it has been estimated that the impact of raising user costs in higher education, by eliminating university student allowances and introducing tuition payments to cover operating costs, would be sufficient to finance substantial increases in enrollment ratios in some countries in Sub-Saharan Africa (Table 10).

**Table 10. Potential Impact on Primary Education in Africa of Increasing Fees in Higher Education**

| <i>Country</i>           | <i>Current enrollment ratio</i> | <i>Potential primary enrollment ratio with full cost recovery in higher education g/</i> |
|--------------------------|---------------------------------|--|
| Benin                    | 65                              | 81   |
| Burkina Faso             | 20                              | 25   |
| Central African Republic | 68                              | 79   |
| Congo                    | n.a.                            | n.a.   |
| Cote d'Ivoire            | 76                              | 100  |
| Malawi                   | 59                              | 91   |
| Mali                     | 27                              | 35   |
| Niger                    | 23                              | 26   |
| Senegal                  | 48                              | 81   |
| Sudan                    | 51                              | 73   |
| Tanzania                 | n.a.                            | n.a.   |
| Togo                     | n.a.                            | n.a.   |
| Average                  | 49                              | 66   |

n.a. Not available

g/ Full cost recovery refers to the elimination of university student allowances and introduction of tuition payments to cover operating costs.

Source: World Bank (1986, pp. 22, 23).

Such estimates are only illustrative of what is feasible. More recent studies incorporate behavioral concerns. The general empirical approach is to use micro-econometric techniques to estimate the effects price changes have on behavior and then to use the results as parameters to simulate the eventual effects on the use and availability of the service.

Most of the studies focus on the demand side to estimate the effects of price changes on utilization and revenue. A series of studies on the impacts of price changes on health demand has been done on Malaysia (Heller, 1982); the Philippines (Akin et al., 1986); Côte d'Ivoire (Dor and van der Gaag, 1987 and Gertler and van der Gaag, 1991); Ghana (Gertler and van der Gaag 1991 and Lavy and Quigley, 1991); Kenya (Ellis and Mwabu, 1991; Mwabu, 1986 and Mwabu et al., 1992); Nigeria (Akin et al., 1991); Peru (Gertler et al., 1987) and Pakistan (Alderman and Gertler, 1989). While a detailed review of these studies is beyond the scope of this paper, a general outline of the procedures used would be useful.

Discrete choice models are typically used to obtain estimates of demand price elasticities. The left-hand side dependent variable is often measured



as the incidence of use of various kinds of health facilities (for example, private doctor, public facility, traditional healer), through the Lavy and Quigley study is different in that it also measures intensity of use. These price elasticities are then used to show how revenues will be affected by increasing prices, as measured by independently-collected unit prices in a locality or as proxied by the time costs of access. Table 11 shows some basic results. A common finding is that the utilization of health services tends to be relatively price inelastic, so that a unit increase in prices will lead to an increase in revenues. Moreover, these are estimates at a single point along the demand curve -- many of the studies show that demand may be relatively more price elastic at lower levels of utilization and income.

The models of education demand are similar to those of health (Peru, Gertler and Glewwe 1990; Malawi, Tan et al., 1984). More measures are used for demand. At the household level, it could be the number of children in school; at the individual level, the use of various types of discrete categories of education facilities and completed years of schooling (relative to the number of years possible) are also used. The qualitative results, also shown in Table 11, do not differ much from those found in health.

Table 11. Price Elasticities of Demand for Health and Education Services

| Year of Data | Country and service        | Price range (U.S. dollars) | Overall                | Price elasticity by income group |                  |
|--------------|----------------------------|----------------------------|------------------------|----------------------------------|------------------|
|              |                            |                            |                        | Lowest quartile                  | Highest quartile |
| Health       |                            |                            |                        |                                  |                  |
| 1985         | Côte d'Ivoire <sup>a</sup> |                            |                        |                                  |                  |
|              | Clinic                     | Free to \$.11              | n.a.                   | -0.61                            | -0.38            |
|              |                            | \$.11 to \$.22             | n.a.                   | -1.16                            | -0.05            |
|              | Hospital                   | Free to \$.11              | n.a.                   | -0.47                            | -0.29            |
|              |                            | \$.11 to \$.22             | n.a.                   | -0.86                            | -0.51            |
| 1985         | Peru <sup>a</sup>          |                            |                        |                                  |                  |
|              | Private doctor             | Free to \$1.56             | -0.14                  | -0.20                            | -0.06            |
|              |                            | \$1.56 to 3.12             | -0.29                  | -0.44                            | -0.12            |
|              | Hospital                   | Free to \$1.56             | -0.41                  | -0.67                            | -0.33            |
|              |                            | \$1.56 to \$3.12           | -0.64                  | -1.18                            | -0.05            |
|              | Clinic                     | Free to \$1.56             | -0.46                  | -0.76                            | -0.03            |
|              |                            | \$1.56 to \$3.12           | -0.68                  | -1.28                            | -0.06            |
| 1975         | Malaysia                   |                            |                        |                                  |                  |
|              | Outpatient visits          | n.a.                       | -0.01                  | n.a.                             | n.a.             |
| 1981         | Philippines                |                            |                        |                                  |                  |
|              | Prenatal child care        | n.a.                       | -0.01                  | n.a.                             | n.a.             |
| 1980-81      | Kenya                      | \$5.80                     | inelastic <sup>b</sup> | n.a.                             | n.a.             |
| 1985         | Ethiopia                   |                            |                        |                                  |                  |
|              | Outpatient care            | n.a.                       | -0.05 to -0.50         | n.a.                             | n.a.             |
| 1986         | Sudan                      | n.a.                       |                        |                                  |                  |
|              | Outpatient services        | n.a.                       | -0.37                  | n.a.                             | n.a.             |
| Education    |                            |                            |                        |                                  |                  |
| 1985         | Peru <sup>a</sup>          |                            |                        |                                  |                  |
|              | Secondary education        | Free to \$1.56             | -0.14                  | -0.18                            | -0.20            |
| 1982         | Mali <sup>c</sup>          | n.a.                       | -0.98                  | n.a.                             | n.a.             |
| 1983         | Malawi <sup>d</sup>        | n.a.                       | -0.52                  | n.a.                             | n.a.             |

n.a. Not available.

a. These are price elasticities, which is why price ranges are relevant.

b. Uses household enrollment ratio as dependent variable.

c. Uses distance as price variable.

d. Magnitude could not be computed from available data.

Sources: Gertler and van der Gaag, 1988 for health in Côte d'Ivoire and Peru; Gertler and Glewwe, 1988 for education in Peru; Akin et. al., 1986 for the Philippines; Mwabu, 1988 for Kenya; Dunlop, 1987 for Ethiopia; Birdsall et. al., 1983 for Mali; Tan et. al., 1984 for Malawi; Schwabe, n.d. for Sudan.

These price elasticities can be used to compute the welfare gain associated with a price increase, given the budget-constrained analytical

framework outlined above.<sup>37</sup> The estimated revenue generated from the user charges can finance either an expansion of supply or an improvement in quality. Some of the studies outlined above take this additional step in the analysis. For example, Ellis and Mwabu (1991) use the quality variables being held constant in the demand equation to try to infer willingness to pay for marginal changes in some of these characteristics, and they conclude that significant quality improvements can be financed by user charges (Table 12). Mwabu et al. (1992) finds that, in Kenya, the availability of drugs and trained personnel affects demand and should be taken into account in the analysis.

**Table 12. Individual Willingness to Pay for Access to Social Services and the Cost of Provision (1985 U.S. Dollars)**

| <i>Country and service</i>             | <i>Willingness to pay for obtaining<br/>access to a nearby facility when the<br/>alternative is:</i> |                       | <i>Marginal<br/>Cost</i> |
|--|--|-----------------------|--------------------------|
|  | <i>One hour away</i>   | <i>Two hours away</i> |                          |
| <i>Côte d'Ivoire</i>                   |  |                       |                          |
| West Forest Health Clinic <sup>a</sup> | 0.10   | 0.17                  | 1.30                     |
| Savannah Health Clinic <sup>a</sup>    | 0.03   | 0.06                  | 1.30                     |
| <i>Peru</i>                            |  |                       |                          |
| Coastal Health Clinic <sup>a</sup>     | 0.09   | 0.17                  | 2.73                     |
| Sierra Health Clinic <sup>a</sup>      | 0.00   | 0.02                  | 2.73                     |
| Secondary School <sup>b</sup>          | 14.29  | 104.64                | 35.71                    |

a. Dollars per visit.

b. Dollars per academic year.

Sources: Health: Gertler and van der Gaag (1988, Tables 5 and 6). Education: Gertler and Glewwe (1989).

<sup>37</sup>If the public sector rationed efficiently across sectors, the shadow value of a dollar of public revenue would be sufficient to infer welfare improvements. However, the pricing literature for education and health assumes that insufficient funds are being devoted to education and health services.

While these recent studies have gone a long way towards addressing a gap in policy analysis, the literature still needs to evolve. First, future policy work must have more studies on which to rely. The methods and results of the studies that are currently available are varied enough to caution against deriving many conclusions that can be widely applied. Future studies will continue to confront the problem that little information is available that combines users' socioeconomic characteristics with data on utilization and on the characteristics of facilities like schools and hospitals. For example, the prices of using a service like education and health are very difficult to obtain. In education, many public schools charge no prices at all; in health, provider-reported average prices of visits to clinics, such as those used by Akin et al. (1985), do not take into account *ad hoc* price discrimination by providers or the possible existence of health insurance, both of which complicate pricing measurement. Many studies have thus tended to use proxy variables or indirect measures for prices, such as those from hedonic price equations (for example, Gertler et al., 1987), travel time (for example, Dor et al., 1987 and Gertler and van der Gaag, 1990) or the charge at the nearest alternative facility of each type (for example, Mwabu et al., 1993). It is thus difficult to compare the parameters estimated from the studies.

Data concerns are being alleviated by recent initiatives to collect multi-purpose surveys in developing countries. One such initiative, the Living Standards Measurement Study (LSMS) of the World Bank, has been applied in almost a dozen countries and the data have been used in many of the studies cited earlier (see Grosh and Glewwe 1993 for a description).

There are also empirical challenges that go beyond data. The studies above tend to underestimate the true benefits of a policy reform if there are externalities and no studies take such effects into account. Another issue is that many of the empirical models impose a great deal of structure on household models (such as logarithmical additive utility functions). While such models allow the analyst to map out the preference function and use it for behavioral models, most of the studies have not tested for the robustness of their conclusions in case other structures might imply different results.

Finally, most of these empirical studies are flawed by simplistic assumptions about supply-side responses. Most assume constant cost. One study that directly estimates the cost functions of the facilities to infer what the supply response might be is that of Akin et al. (1991). They use this to do simulations on the effects of different types of investment policy. Unfortunately, they use a very limited Nigerian sample that consists only of those households that report an incidence of illness. More studies about the cost structure of education and health services are needed.

Another assumption is that resources will actually be used to finance expansion or improvements in quality. This is partly dependent on the specific actions of government and can only be evaluated on the basis of actual experience. Where this experience exists, this evidence will also be useful to use against those who argue that such policy changes cannot be made because of reasons of political or administrative costs.

Efficiency: evidence from actual experiments. There have been relatively few attempts to raise fees in education, health and water services, and even fewer instances where such attempts have been rigorously documented and evaluated. In health, detailed case studies of four African, one Asian and four Latin American countries have been documented; these include studies in Ghana (Waddington and Emyimayew, 1989), Zaire (Creese, 1991), Swaziland (Yoder), Lesotho (Creese, 1991), Bangladesh (Santon and Clemens, 1989), Cameroon (Litvack and Bodart, 1992), Dominican Republic, Honduras, Jamaica and Brazil (Lewis, 1991a, b).<sup>38</sup> These actual case studies share the following conclusions. First, they show that raising charges is feasible and that political and administrative costs can be overcome. This is particularly true in health -- the evaluation of education reform has yet to be done. In this regard, incentives matter; hospitals and clinics that retained control of their funds were able to generate more funds.

Second, the impact on revenue mobilization has also been positive -- user fees can raise substantial amounts, although it remains to be seen what

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<sup>38</sup>There are other cases in which fee increases have been attempted. However, either they have only just begun as experiments (such as in Indonesia) or they have not been fully documented in scholarly work.

the government has actually done with the money. In the Latin American examples, the fees actually went to buy more supplies and drugs.

Third, the impact on the utilization of services is mixed. In almost all countries, utilization went down -- partly because the fees were raised dramatically (so that this finding is not necessarily inconsistent with the demand findings above). But, in several other countries, they recovered after only two years.

The number of actual cases is still relatively small and is practically non-existent in the case of education. Perhaps most important, the experiments in the case studies are not rigorously designed. These types of studies are still being designed and until they are finished, the debate is likely to continue to rage.

Equity: some conceptual issues. The earlier section has already shown that free provision does not necessarily mean that the poorest income groups have access to certain services. There are several reasons for this. One is that, even at zero or a very low price, social services are costly to use. The private cost includes payments for transport, materials (medicine in the case of health, or school books in the case of education) and opportunity cost (particularly high for education, but might be high in terms of waiting time for other services). For education, the opportunity cost alone can amount to 25 to 50 percent of the total social (private plus public) cost of education (Jimenez, 1987, p. 19). Even though poor adults may have a lower opportunity cost of time than richer adults, this relationship may be reversed for children -- poor children may tend to work at home and may find it more difficult to attend school.

Another reason is that, when demand is rationed, the rationing system often favors those who are relatively well off, unless the services are carefully and deliberately targeted. For example, rationing of school places, nominally by ability, may in fact favor richer households that can afford to pay for tutoring or to let their children repeat a grade. The same may be true of rationing by concentrating the service in certain areas, like urban centers.

Rationing by means of requiring beneficiaries to spend time waiting for a service such as health care or to travel long distances for water can favor the relatively poor if the price of a wait is higher to those with a higher opportunity cost of time (Briscoe et al., 1993). But the benefits from redistributing income in this way should be compared to the benefits of improved benefits financed by higher taxes. Moreover, the costs can be high if the government can redistribute income effectively by direct transfers (Bucovetsky, 1984) or other allocation mechanisms (Sah, 1987), or if the benefits are unevenly distributed among those who wait.

When such considerations are important, differential prices for different services can significantly improve efficiency and equity. It has been shown empirically, for example, that higher income groups tend to benefit disproportionately from higher education, so that shifting government spending from that level to more basic levels will have a bigger impact on reducing poverty (World Bank, 1986, 1987a; Mingat and Tan, 1985, 1986; Griffin, 1992).

Moreover, the inequalities of government spending have also been used as an argument for using targeting to redistribute wealth. The benefits and costs of targeting are discussed more fully in the chapter by Lipton and Ravallion. Recent evidence for targeted health or education programs indicate that such techniques could be administratively feasible (Grosh, 1993), particularly if they do not involve explicit means testing but instead target by category (such as age, gender or location) using characteristics that are highly correlated with indicators of poverty.

Equity: evidence. The previous section has shown that the popular method for ensuring access has been to provide all social services at a heavy per unit subsidy through uniformly low or zero prices, accompanied by quantity rationing or low quality when budgets are tight. This has not been successful as the highest subsidies often go to services used mainly by the rich such as higher education and urban-based health care. In principle, differential pricing -- increasing prices (or lowering subsidies) for those services that are consumed primarily by the rich and increasing subsidies for those services that are consumed primarily by the poor -- is bound to have beneficial

effects, particularly when the initial differences in cost are great and the distribution of access to various service levels is very unequal.

For example, according to figures in Table 13, Asian countries fall roughly into three groups: (i) those where education subsidies are roughly equitably distributed according to levels of education (Korea and the Philippines); (ii) those with moderately equitable distributions (China, Indonesia, Malaysia, Sri Lanka and Thailand); and (iii) those with fundamentally inequitable distributions (Bangladesh, India, Nepal and Papua New Guinea). Since students from richer families will tend to be overrepresented at higher levels of education, it can reasonably be concluded that differential pricing would be more progressive in the last group of countries.

*Table 13. Distribution of Public Spending on Education, Selected Asian Countries, mid-1980s*

| <i>Country</i>   | <i>Gini coefficient g/</i> | <i>Cumulative spending received by 10 percent best-educated (percentage of total cumulative spending)</i> |
|------------------|----------------------------|---|
| Bangladesh       | 81.9                       | 71.7  |
| China            | 44.4                       | 31.1  |
| India            | 65.8                       | 60.8  |
| Indonesia        | 27.3                       | 21.4  |
| Korea            | 15.9                       | 13.4  |
| Malaysia         | 37.9                       | 32.0  |
| Nepal            | 57.9                       | 53.5  |
| Papua New Guinea | 62.1                       | 53.5  |
| Philippines      | 18.6                       | 14.1  |
| Sri Lanka        | 32.6                       | 28.1  |
| Thailand         | 32.9                       | 23.3  |
| Regional average | 43.4                       | 36.3  |

g/ This statistic has a range of 0 to 100. The closer it is to 100, the more unequal is the distribution of public spending on education in a school-age population.

Source: Tan and Mingat, 1992.

One consideration is that there are relatively few human services that are not consumed by rich and poor alike. Some urban-based specialty hospitals



cater solely to diseases that afflict the relatively wealthy, and, in Africa, education is so selective that, by the tertiary level, the elite form a vast majority of all applicants (World Bank, 1986, 1987a). However, in other countries and services, the poor represent a minor but still significant portion of students at primary or middle levels or of patients in urban hospitals. In these cases, it is important to measure the initial distribution of subsidies very carefully and to make appropriate judgments as to how they might change as a result of the change in policy.

Another consideration is that there may be externalities or other reasons why ensuring that the poor have access to higher-level services is important to a society. There may also be political reasons for wanting to guarantee, for example, that poor students who have managed to work their way through secondary school have a chance to enter university or that poor children with an operable heart condition have a chance to have life-saving operations. More importantly, there may be economic efficiency reasons for this because credit markets for education and insurance markets for health are only just starting up in many developing countries. Such concerns are validated some recent empirical work (Gertler et al., 1987; Gertler and van der Gaag, 1988 and Gertler and Glewwe, 1989) that shows that the price elasticity of demand for social services may be higher among the poor than among the rich. Thus, for a given price increase, the consumption of the poor would fall proportionately more than that of the rich. This is corroborated by some recent case work in Ghana. When fees for attendance at health stations were raised, there was an initial drop in attendance at urban-based stations but the numbers soon went up again, whereas attendance at small, rural-based health stations remained at a lower level, even after two and a half years (Waddington and Enyimayew, 1989).

As a result, many argue that, where possible, user charges, even if differentiated by type of service, should also be accompanied by more narrowly-targeted subsidies to ensure that the poor continue to have access to the service in question. As reviewed in the chapter by Lipton and Ravallion, however, the relative costs of various targeting mechanisms have to be weighed carefully. Means testing of individuals, while generally administratively

costly to implement, may be quite appropriate for relatively small programs that draw from a limited population where monitoring is easier (see Grosh 1993 for a comprehensive review). One such example may be university scholarships where a student's background is arguably relatively easy to determine and where parents are likely to be reasonably well educated (see Klitgaard, 1986 for an interesting discussion of some cases).

There are various alternatives to individual means testing. Studies of food subsidies have found that targeting using physical criteria, such as nutrition level, is generally more effective in reaching target populations and in keeping others out than using income criteria, although individual testing may be costly (for example, see Edirisinghe, 1987 and Garcia and Pinstруп-Andersen, 1987). Similar criteria that have been applied in developing countries are health status (incidence of certain diseases) or adult literacy (Griffin, 1989). A more realistic category to use for targeting is geographic location. The rule of exempting institutions from fees in urban slums or obviously poor rural areas also makes it easier to implement. The one drawback is that, if two neighboring locations have vastly different rates, people may migrate in order to qualify for the cheapest alternative (Rosenzweig and Wolpin, 1986).

Self-selecting mechanisms are often suggested as a way to target in a way that minimizes the administrative burden. Most of these are based on the concept of quality. For example, long waiting lines can be used to take advantage of the fact that the opportunity cost of time is greater for rich than for poor people. Another example is that lower quality facilities tend to attract only the poor (Besley and Coate 1992).

Feasibility. One aspect of feasibility is administrative cost. While it is true that public administration in many developing countries is generally weak, a few case studies indicate that the administrative problems associated with collecting fees can generally be overcome if the appropriate incentives are put in place. For example, the salaries of the administrative staff could be related to the amount of fee income they recover. Even more importantly, institutions could be allowed to retain a percentage of the fee income that they raise. In many countries, these fees must be remitted to the

central finance ministry. According to Vogel (1988, 1991), in Côte d'Ivoire and Senegal, almost 100 percent of fees has to be handed over to the finance ministry, while in Mali, it is all remitted to the central health ministry. However, in Ghana, the institution was able to keep 25 percent.

The financial costs of recovering fees are not overwhelming. Generally, the cost of collecting fees, including incentive payments to collectors, amount to about 10 percent of total fees collected -- some outliers indicate 25 percent (Vogel, 1988). Hecht et al. (1992) documents a plan for a relatively comprehensive reform proposal for price reform in Zimbabwe, and concludes that fee collection is indeed administratively feasible (see also Wouters, 1991, and Yoder, 1989).

Another aspect of feasibility is political. Governments may be acting in their own rather than in the public interest. Another possibility is that some governments may be unable to withstand pressure from powerful minority interests (Birdsall and James, 1993). Such pressures may explain the persistence of the unequal distributions found in certain countries in terms of access to higher education and health care.

Political constraints can be a real barrier to reform. However, it is possible to take measures to counteract them. One is to compensate those who will lose out as a result of the reform and, at the same time, to mobilize those who will gain from it. This can only be done by a massive public information campaign, as occurred in Ghana, to alert the population to the inequities of the existing distribution of subsidies (World Bank, 1988c). Another is to rely on rules rather than discretion -- for instance, by greater earmarking. This may not work if the discretionary portion of the funds is used to counteract the non-discretionary portion. Moreover, there may be heavy efficiency losses associated with this (McCleary, 1988).

Conclusions. In short, although there is much merit in the conceptual arguments for increasing prices in the social sectors, empirical support is only now beginning to build. There is strong evidence that there is much room for improvement, in that present subsidies could be directed more towards the poor. Moderate increases in user fees would raise revenues because demand is relatively price inelastic, but dramatic increases designed to recover costs

in full would not be feasible because of the lack of adequate credit or insurance markets and because demand elasticities may rise. Finally, practical methods exist for protecting the poor.

The remaining problems are the need to:

- assess the feasibility of measures to protect the poor;
- reach agreement on which services should have fees raised and by how much, in other words, a need for operational "rules of thumb";
- gather information about the cost structure of service provision; and
- make systematic evaluations of actual attempts to raise prices.

### Physical Infrastructure

For most physical infrastructure services, the pricing discussion has primarily been motivated by a different set of externalities than those emphasized in human infrastructure, where most of the consumption externalities are positive. In physical infrastructure, many of the externalities are decidedly negative -- congestion in the use of electricity, road and water services, damage caused to other users from a road that deteriorates with each use, and, increasingly, pollution from road and water traffic and some forms of power generation.

The discussion on pricing physical infrastructure has also been influenced heavily by the fact that most investments have large fixed costs. This means that, in many instances, marginal costs are below average costs, so that some subsidy is required. Also, while pricing at short-run marginal cost would give the firm information about the appropriate time to invest (prices would rise as the plant operated closer to capacity), the price rise at capacity may be unacceptably high before further investment finally alleviates the constraint. Many argue (Anderson, 1989) that long-run marginal costs would thus be a better guide, although this is not universally accepted.

There has been a widespread and longstanding recognition that prices should play a role in resource allocation in physical infrastructure (unlike human infrastructure). The prices should be positive, and should approximate

marginal costs, at least in the long run if not in the short run.<sup>39</sup> The principles of sound demand management and the important role that prices play in signaling the provider how much to invest are generally accepted. But, for many of the physical infrastructure sectors, present practice far from reflects these principles.

Efficiency issues: raising more revenue to cover supply costs. Recent policy studies have found that, in practice, infrastructure prices in developing countries have two disturbing general characteristics relative to what is efficient -- they are too low and they are structured in a way that does not reflect the nuances of the various market failures mentioned in the preceding paragraphs.

There is considerable evidence that present prices in most sectors are very low and are below not only financial requirements but also marginal costs. Electric power is judged to be underpriced in most developing countries. Prices amount, on average, to just above a third of supply costs and are half as much as those in industrial countries (World Bank, 1992b). While consumers in most industrial countries pay all of the recurrent costs of both water and sewerage services plus a large proportion of capital costs, in developing countries, consumers pay much less. For example, a recent review of projects financed by the World Bank showed that the effective price paid for water is only about 35 percent of the average cost of supplying it (World Bank, 1992d; see also Katko 1990, Sampath 1992).

Some subsectors like ports, railways and telecommunications tend to be run more autonomously as state-owned enterprises have a better record in these sectors than in other sectors in implementing a cost-based tariff structure. While the calculations regarding costs are admittedly crude, a selected review of some countries where systematic data exist found that the ratio of revenues to operating costs tended to exceed well over 100 percent for ports and to be close to 100 percent for railways. Cost recovery is also usually high in

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<sup>39</sup>See, for example, a series of studies for the World Bank by Churchill (1974), Walters (1968), Bennathan and Walters (1979), Saunders and Warford (1976), Saunders et al. (1983), Turvey and Anderson (1977), Bahl and Linn (1992) and Munasinghe and Warford (1982), which cover most of the physical infrastructure sectors with which institutions work.

telecommunications (Julius and Alicbusan, 1989). Some recent analysts have defined road taxes and charges broadly -- including the purchase tax on vehicles, taxes on diesel fuel and gasoline and license fees, as well as tolls and other direct prices -- and have ignored any pure tax elements in concluding that many developing countries collect considerably more user charges than is spent on roads (Heggie, 1991). While it is difficult to accept the assumption that all such taxes and charges can be interpreted as user charges, even for these sectors, the efficiency issues are similar to those posed for the sectors that experience chronic deficits. The expenditures fall far short of what is required for maintenance (Anderson, 1989 and Heggie, 1991). Moreover, some raise the question of whether prices should be increased even more, given that other methods of revenue raising are costly.

Given these initial conditions, the magnitude of the revenues that can be generated by increasing prices can be substantial. Table 14 summarizes some calculations made in the case of Africa (Anderson, 1989). For electricity and water, the gain was computed by assuming that an increase in the real financial rate of return of around 5 to 10 percent was feasible. For telecommunications, actual tariffs were compared to long-run marginal costs. For roads, a substantial increase in user charges of 50 to 75 percent above current levels appeared justified to take into account the costs of maintenance. The calculations imply an increase in revenue of about 23 percent, which is sufficient to cover recurrent costs and earn adequate financial rates of return. Moreover, as most of this is in the form of user charges, deadweight losses would be low; even for road taxes, elasticities are shown to be relatively small. Anderson also points out that raising revenues in this way would ensure the financial autonomy of institutions, which could then attract private capital for investment.

**Table 14. Incremental Effects of Raising Prices and User Charges  
Sub-Saharan Africa (1980s)**

| <i>Sector</i>      | <i>Current contribution<br/>to public revenue</i> | <i>Potential contribution<br/>as % of public revenue</i> |
|--------------------|---|--|
| Electricity        | Small or negative                                 | 5-10   |
| Water              | Small or negative                                 | 2-5  |
| Telecommunications | Marginal  | 5-10   |
| Roads              | 10-15%  | 5-10   |

Source: Anderson, D. "The Public Revenue and Economic Policy in African Countries", World Bank Discussion Paper No. 19, 1987.

Are these gains feasible? Anderson states that:

"The financial surpluses from marginal costs pricing (and also from any infrastructure taxes) would be relatively easy and inexpensive to administer. They would be a near costless part of the billing services for electricity, telecommunications and water supply, and of the user charges for roads (license fees, parking fees, gasoline taxes, etc.)" (p. 530).

Unfortunately, he does not present any evidence on this point, and the issues of calculating, monitoring and administering efficient user charges remains an important debating area in the literature, and will be discussed further below in the context of addressing externalities.

Does this mean that infrastructure prices can be a good instrument for general revenue raising, given the high deadweight losses associated with commodity taxes?<sup>40</sup> If these charges are to be considered as an indirect tax, they should be evaluated like one. The case of roads has been examined in this way (Newbery, 1988). The road price can be considered to have two elements: a road user charge to ensure sectoral efficiency (in other words, to take into account congestion and road damage, as discussed below) and a pure tax element, which is the amount by which road taxes exceed road use cost. If the economy were competitive and externalities could be corrected,<sup>41</sup>

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<sup>40</sup>Heggie (1991) and Fon and Heggie (1991) advocate such a policy for developing countries. See also Laferriere and Nalo (1992), Mwase (1988, 1989).

<sup>41</sup>These meet a more general set of conditions discussed formally by Diamond and Mirrlees (1971) -- that production efficiency is feasible and that any resulting private profits are negligible or can be taxed away.

then policies should be designed to achieve production efficiency and all distortionary taxes should fall on final consumers (to avoid cascading effects of distortions). Newbery (1988) points out that, under these conditions, "freight transport should pay the efficient road user charge; passenger transport may be subject to additional pure taxation". (p. 121) The latter is particularly attractive in light of Deaton's finding (1987) that household spending on gasoline car purchase and maintenance is relatively income-elastic in developing countries (see also Oum et al, 1990).

Should the funds be earmarked for operations and maintenance, given that so many recent studies pinpoint this as the most important priority area for further investment, as discussed in Section 3? This is an argument made by many who work within the sectors (see, for example, Johanson, 1989), while analysts and policymakers dealing with general economics feel that earmarking is a controversial policy subject. The pros and cons of earmarking are beyond the purview of this paper.<sup>42</sup> However, some general principles are reasonably clear. The user charge portion of the price should be spent on expanding or maintaining the infrastructure, depending on which has the higher return. Revenues from the tax portion of the price should be treated like taxes -- and, if the government has reasonable expenditure allocation mechanisms, operations and maintenance should be considered along with other worthwhile investments. If not, then one should investigate the possibility of removing discretion from central authorities as the best way to achieve better resource allocation.

Efficiency issues: correcting for negative externalities. Prices in physical infrastructure can be used to correct for the principal negative externalities imposed by a user on others: congestion (as in the decreasing reliability of power supply as more users are connected to the grid), damage to the infrastructure (as in road damage causing higher costs of maintenance to the public authority and of repair to other vehicle owners) and, in some cases, pollution. The principles are reasonably clear for each of the subsectors.

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<sup>42</sup>For a good summary of the principal issues, see McCleary, 1991.



In road transport, the ideal is to charge vehicles the cost of using the road each time. This cost will include damage and congestion. Road damage is relatively straightforward -- a combination of vehicle-specific and distance-related charges (such as on axles, fuels, vehicle parts or purchase have been suggested).<sup>43</sup> Congestion is more problematic because of the large differences between peak and off-peak road usage. Metering can be especially difficult, unless some new electronic technology is developed as has been tried on a pilot case in Hong Kong (see Hau, 1990). Otherwise, proxies are used as second-best instruments. One of the most successful has been access charges that are area-specific, as has been tried and is still in practice in Singapore (see Watson and Holland, 1976, for a thorough evaluation). Fuel taxes are a particularly blunt instrument in this regard since they are related to distance rather than congestion. One simulation of how these various types of charges can be combined are summarized for commercial vehicles in Tunisia in Table 15. The table shows that different types of prices will have differential impacts on various types of vehicles.

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<sup>43</sup>Small et al. (1989) and Newbery (1988).

**Table 15. Illustrative Road User Charges for Commercial Transport in Tunisia, 1983**

| <i>Vehicle class</i> | <i>(Road use costs (U.S. cents per kilometer))</i> |                                 |                             |                  | <i>Diesel tax rate (U.S.cents per liter) (5)</i> | <i>Purchase tax rate (percent) (6)</i> |
|----------------------|--|---------------------------------|-----------------------------|------------------|--|--|
|                      | <i>Road damage (1)</i>                             | <i>Non-urban congestion (2)</i> | <i>Urban congestion (3)</i> | <i>Total (4)</i> |  |  |
| Utility (pickup)     | 0.03   | 0.15                            | 1.46                        | 1.64             | 18.22  | 26                                     |
| Truck Class          |  |                                 |                             |                  |  |  |
| Light                | 0.12   | 0.21                            | 1.94                        | 2.27             | 15.13  | 20                                     |
| Medium               | 0.51   | 0.33                            | 0.44                        | 1.28             | 6.40   | -4                                     |
| Heavy Single         | 2.18   | 0.39                            | 0.52                        | 3.09             | 7.92   | 2                                      |
| Heavy tandem         | 4.46   | 0.39                            | 0.52                        | 5.37             | 12.07  | 17                                     |
| Articulated          | 5.64   | 0.41                            | 0.44                        | 0.44             | 13.33  | 11                                     |

- a. The rate needed to cover road use costs fully through a tax on diesel.
- b. Tax scheme A stipulates a diesel tax of six cents per liter, a tire tax of 10 percent, and a tax on parts 10 percent the purchase tax rate is the rate needed to equate charge to cost.
- c. Tax scheme B stipulates a diesel tax of three cents per liter, a 20 percent tire tax, a 20 percent parts tax, and a purchase tax as set; the balance is the amount needed to equate charge to cost (possible license fee).

Source: Newbery, 1988.

Road prices have implications for pollution and, depending on the form they take, on other sectors in the economy. It has been shown that the pollution externality would add another term to the optimal price formula.<sup>4</sup> However, there have been no studies that explicitly measure how a charge can be made for pollution in road pricing in developing countries. Eskeland (1992), in the context of Mexico, estimates that the range of instruments to do so would vary and could very well include regulatory as well as tax-related

<sup>4</sup>See Eskeland and Jimenez (1992) for an intuitive explanation and for applications to developing countries.

interventions. Another consideration is that blunt instruments like fuel taxes may have substantial repercussions elsewhere in the economy and, if so, their effects should be taken into account. Studies by Hughes (1986) in Indonesia, Thailand and Tunisia used an input-output table, a model of price-shifting behavior and an estimated system of demand equations to analyze these effects. The data requirements were obviously very heavy, for the study had to be replicated in many other countries.

For water, the issues are rather different. Here, the literature has stressed the metering issue, particularly for irrigation where it is virtually impossible to control who has access to the service. One option is for the government to deal with water users' associations (WUAs), which are charged with dealing and negotiating prices with the national irrigation authority. The WUA then negotiates with individual farmers and monitors use locally. Such schemes have worked well in the Philippines and elsewhere (World Bank 1988c).

Equity issues. There have been relatively few studies of the impact of various infrastructure pricing schemes on equity. Since the majority of infrastructure services are in urban areas and the distribution of income favors those living in these areas, raising prices there will not affect the poor as much as raising them elsewhere would do. Even within urban areas, coverage is often such that the rich are the ones who obtain access.

For example, Table 7 has already shown that prices charged by private water vendors in selected cities around the world are much higher than those charged by public utilities, and it is often the poor who must buy water from the former and the rich who have connections to the latter. This is partly the reason that, in the few case studies in Latin American comparing the incidence of various types of infrastructure intervention, urban-based water subsidies are relatively regressive (Table 6b). Thus, charging more for such utilities may not be that regressive.

Moreover, recent research has found a high level of willingness to pay even in rural areas (Briscoe et al., 1993), although it is important to distinguish among different types of communities. In studies of rural water demand in Brazil, Haiti, India, Nigeria, Pakistan, Tanzania and Zimbabwe,

researchers used both contingent valuation and revealed preference methods of inference to conclude that most rural people want and are willing to pay for a relatively high level of service (yard taps) and are willing to pay substantially more if that service is reliable. In other types of communities, only a minority of households are willing to pay for private connections, but most are willing to pay for some if not all of the costs of public connections. In some of the poorer communities where supply costs are high, public taps could be subsidized.<sup>4</sup>

There are also ways to protect the poor by block pricing in which higher unit prices are charged at higher levels of consumption, as has been tried in Brazil, Colombia and Indonesia (World Bank, 1988c). An extreme example of this would be a lifeline rate in which, up to a certain threshold, consumption is free and is charged at marginal cost thereafter. However, such charges should take into account patterns of use. The poor could end up paying higher unit prices than the rich if the former relied on communal taps (which have high volumes) and the latter relied on private taps (which have low volumes). In such a case (documented in the case study by Whittington, 1990), volume-based pricing would not serve the poor as well.

For road taxes, evidence indicates that, in transport, some combinations of instruments are neutral; for example, gasoline taxes are progressive while diesel plus kerosene taxes are regressive and so they balance each other out (Newbery, 1988).

**Conclusions.** For physical infrastructure, unlike in education and health, there has been a longstanding acceptance that prices should be set high enough to cover marginal costs. The main issues have to do with implementing these principles -- particularly in practical ways to account for congestion and pollution externalities; metering problems; accounting for fiscal realities in pricing; and in adjusting prices to account for distributional objectives.

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<sup>4</sup>The study also identified communities where the willingness to pay for any kind of improved service is low because traditional water supplies are relatively easy to get or the provision of this service is seen as the financial responsibility of government.

## 5. Summary and Future Directions

The recent literature has reinforced the point that human and physical infrastructure are critical elements for economic growth and for the reduction of poverty. Despite data limitations and methodological difficulties, studies espousing these ideas, briefly reviewed in Section 2, have permeated the formulation and application of policies, as practiced by governments and as supported by international funding agencies.

There is also a continuing recognition that, because of externalities, scale economies, other public goods characteristics, and because of distributional objectives, the government has a key role to play in financing and supplying infrastructure. But recent studies summarized in Section 3 have raised fundamental concerns with how such intervention has been practiced. The efficiency objective is often not met -- the highest return investments are not being given priority; and the services that are being provided are not being provided at least cost. Even more alarming is the fact that, despite spirited rhetoric and clearly stated national goals to ensure access to all, but especially the poor, the equity objective is often not met either. At the root of those failures are constraints that are often neglected in planning models: administrative capacity of government is weak; rents are often sought and obtained by private interest groups, leading to distorted outcomes; operational tools to implement conceptual sound advice are often lacking.

But what then can be done to ensure that infrastructure services are more adequately financed and that what is spent is better directed towards priority investments? The recent literature on these issues is vast and diverse, even within each of the sectors that can be classified as "infrastructure."<sup>4</sup> Section 3 presented selected examples of how received textbook analysis is being revisited in the policy debate, only some of which is backed by rigorous and empirically-based analysis. Recent initiatives have

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<sup>4</sup>Moreover, many of the papers are interesting and policy-relevant but cannot be classified as scholarly research -- they tend to be position papers, although many are indeed based on rigorous background studies. See, for example, the recent World Development Reports of the World Bank.

attempted to relieve the two main constraints to sound public decision-making -- a lack of information and a lack of incentives. These initiatives have included refining economic tools of analysis, particularly those for making inter-sectoral allocation decisions in spending and those that take into account general policies in setting sectoral policies, building better incentives into investment choices, particularly through decentralization, and allowing for greater private sector provision in certain subsectors, while ensuring that the government maintains an important regulatory role.

Pricing reform is another of the policy initiatives that has recently been given much attention. Once a government has decided where to invest, it must then decide how much to charge for the use of that service. Section 4 focused on the recent literature on pricing reform, which fundamentally revisits the public-private balance in the financing of infrastructure. There has been an after emotional debate about pricing those services that produce human capital, since education and health have traditionally been provided for free by the public sector. In physical infrastructure, the issues are somewhat different. In transport, energy and, to a lesser extent, water, pricing to achieve economic efficiency has always been accepted in principle. However, the principles have traditionally not been applied so the recent literature on these sectors has also focused on the need for reform.

This review has also identified key areas for future research. First is the need to improve data quality and availability. At the aggregate level, the empirical link between infrastructure and productivity can be strengthened with improved measures of outcomes (particularly in human resources). At the household level that combines information about socioeconomic characteristics of consumers as well as their access and use of infrastructure.

Second, while there have been major recent advances, there is a need to apply more widely and selectively econometric corrections to problems regarding selectivity and simultaneity bias. This includes research in topics such as the microeconomic link between productivity and infrastructure, as well as in behavioral studies of household demand for infrastructure services. For example, there are relatively few studies using such corrections showing how roads, power and other forms of physical infrastructure affect

productivity of firms and household welfare. Also, more research would be useful on how household utilization of physical and human infrastructure services are affected by changes in price and quality, the most important variables affected by government policy.

Third, some key areas remain relatively unexplored empirically. For example, estimates of the benefit incidence of infrastructure services generally do not adjust for household behavior. This may be important if private transfers are affected by public transfers thus influencing the net impact of receivers of publicly subsidized infrastructure. Another example of a relatively unexplored area is how decentralized provision of infrastructure -- whether by local public institutions or by private firms -- can affect efficiency and equity.

Fourth, some conceptual issues remain to be solved. These include political economy questions and how policy recommendations may change when endogenous government behavior is taken into account. Another issue is to develop analytical tools to address the issue of intersectoral allocation. Finally, given that much of infrastructure will continue to be provided or regulated by public institutions, there is a need to look into the incentive framework influencing such sectors.

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ADD ON: Insert the ff on the role of externalities in policy:

These ideas have important implications for policy, such as investment in infrastructure. The traditional growth models implied that economic policy had a limited role. The rate of per capita growth is determined only by the exogenously determined rate of technical change -- the economic forces determining that change are not explained by the early models. Thus, "economic policy only affects the level of economic output or the transition to the steady state" (Easterly et al. 1992, p. 41). In the "new growth" literature, economic policy, such as investment in human infrastructure, is crucial in this process because without it, the amount of private investment will be insufficient to sustain growth, as private agents do not take the external effects of their actions into account in their investment decisions. The most effective policies are those that address the externalities directly.<sup>49</sup>

Why new growth is important to policy:

some of which have important implications for economic policy. For example, Those who employ ad hoc models of economic growth, in which long-term growth over a 25-year period is regressed on initial income and human capital stock (Barro 1991, Barro Sala i Martin 1991) find that the latter has a positive and significant effect when both are included. This is generally taken to be a test for the convergence hypothesis, although some recent work by Easterly et al. (1992) suggests that the results are not conclusive. Those who derive estimating equations from aggregate production functions tend to get insignificant results on education, unless the equation takes into account differences in levels of human capital (Romer 1990, Kyriacou 1991, Lau et al. 1991). This is taken to be verification of the Azariadis and Drazen (1990) conjecture that achieving threshold levels of human capital may be important in obtaining significant results.

To externality section:

This argument hinges on identifying those infrastructure services which require less public involvement than is now the case. There is no "uniquely" correct public/private balance. It depends on the characteristics of the good or service and the country conditions. Easterly (1992) disentangles the effects by sector of economic activity and concludes that investments in truly public goods have a positive effect and significant effect.

From the conclusions: EDITED BY FIORA AND CORRECTED BY MARTA

While public investment must continue to play a key role in providing infrastructure, there is much room to improve its performance. Present spending can be made more efficient by directing it towards high return activities and categories, unit costs can be lowered and subsidies can be directed more specifically towards the poor. But in making policy reforms the reasons why deficiencies exist in developing countries must be considered. For example providing better tools of analysis for making cross-sectoral

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<sup>49</sup>Recent studies broaden the categories of what should be classified as "productive" -- for example, including education, health and even defence (Barro 1990). Studies that use cross-country data on public spending sometimes produce conflicting evidence from that use "outcome" variables, which could have dramatic implications for policy if shown to be robust (will be returned to below).

choices and providing better incentives to public providers by decentralizing some responsibility to lower tiers of government and even the private sector would help to improve the situation in most d.c. In addition, selective pricing reform could raise the resources needed for high-return investments without unduly hurting the poor. There are limits to this, however full cost recovery is not desirable in the case of certain services, particularly those for which complementary financial markets are lacking, and further work is needed on the behavioral response of users and providers to the policy change.

Take new summary from old introduction and then add future research:

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